

EXHIBIT C

**UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA**

THE BOARD OF TRUSTEES OF THE LELAND
STANFORD JUNIOR UNIVERSITY,

Plaintiffs,

v.

AGILENT TECHNOLOGIES, INC., a Delaware
corporation; HEWLETT-PACKARD COMPANY,
a California corporation; HEWLETT-PACKARD
COMPANY, a Delaware corporation; and HP
INC., a Delaware corporation,

Defendants,

AND RELATED CROSS-ACTIONS.

Case No. 3:18-CV-01199 VC

EXPERT REPORT OF ADAM H. LOVE

On behalf of Agilent Technologies, Inc. and HP Inc.

December 9, 2019



Expert Report *of Adam H. Love, Ph.D.*

United States District Court
Northern District of California, San
Francisco Division

Prepared for:
Environmental General Counsel LLP

Prepared by:
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December 9, 2019

*The Board of Trustees of the Leland
Stanford Junior University*

vs.

*Agilent Technologies, Inc.,
and HP Inc.*

CASE NO. 3:18-CV-01199 VC

A handwritten signature in black ink that reads "Adam Love". The signature is fluid and cursive, with the first and last names clearly legible.

Adam H. Love, Ph.D.
Vice President/Principal Scientist

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Introduction

My name is Adam Hamilton Love and I am a Vice President and Principal Scientist at Roux Associates, Inc., located at 555 12th Street, Suite 250, Oakland, California 94607. I have been retained by Environmental General Counsel LLP as an expert on behalf of HP, Inc. and Agilent Technologies, Inc. I was asked to provide opinions regarding the source of site contamination, the divisibility of site contamination, and the apportionment of divisible shares of environmental impacts relating to the site at 1601 S. California Avenue, Palo Alto, California. In this report I present my qualifications, summarize background information regarding the matter, and present my opinions and the bases for those opinions. I was compensated at a rate of \$365 per hour for this engagement. While I have reviewed numerous documents, the documents upon which I relied on in the preparation of this report are listed in the footnotes of this report.

The conclusions stated herein represent the application of my education, training, and experience within the disciplines of engineering, geology, hydrogeology, chemistry, fate and transport, and environmental forensics to the facts and conditions associated with the Site involved with this litigation. The conclusions set forth in this report are based, in part, upon the facts, information, and data that have been produced in the discovery process of this litigation and provided to me by counsel, and/or which I obtained during the course of my investigation. To the extent that any of the underlying facts, information, or data change or are amended, I reserve the right to consider modifying my conclusions and opinions, if necessary and appropriate. I anticipate supplements to this Expert Report may be necessary in the future, as additional technical issues become relevant.

Qualifications

I hold a Bachelor of Arts degree in Geosciences from Franklin & Marshall College (1996), a Master of Science degree from University of California at Berkeley in Material Science and Mineral Engineering (1998), and a Doctor of Philosophy degree from University of California at Berkeley in Civil and Environmental Engineering (2002). I have over 20 years of experience in environmental forensics, site characterization, remediation, and contamination transport analyses.

From 1996 to 2002, I served as a graduate student researcher at University of California at Berkeley, where I participated in contaminant transport and environmental forensic evaluations, including the development of new techniques for environmental pollution reconstruction and allocation. From 2002 to 2009, I served as a scientist at the Forensic Science Center at Lawrence Livermore National Laboratory. My experience working at the Forensic Science Center included: 1) research and development projects – enhancing understanding of pollutant characteristics and development of technology for characterization, remediation, and source reconstruction/contribution analysis, and 2) operations projects – site applications of contaminant transport modelling and source reconstruction/contribution. From 2009 to 2013, I served as Principal Scientist at Johnson Wright, Inc., where I provided consultation services to various private companies and the federal government. I led Johnson Wright's Environmental Forensics practice, where I performed and oversaw corporate best practices for determination of source, timing, and allocation analyses at contaminated sites. Since 2013, I have served as Principal Scientist at Roux Associates, Inc., where I am currently the corporate Practice Area Leader for Litigation Services and continue to provide consultation services to various companies, state and local municipalities,

and federal agencies regarding site investigations, remediation, exposure assessment, and environmental forensics.

I have been involved as an expert at numerous contaminated sites with TCE and/or PCB contamination. Some recent case involving TCE and/or PCBs are: 1) Von Duprin LLC v. Moran Electric Service, Inc. Major Holdings, LLC, Major Tool and Machine, Inc., and Zimmer Paper Products Incorporated (TCE); 2) Chemtronics Inc. v. Northrop Grumman Systems Corp. American Arbitration Association Arbitration. (TCE), 3) Siltronic Corporation v. Employers Insurance Company of Wausau et al. (TCE); 4) Arrow Electronics, Inc. v. Aetna Casualty & Surety Co., et al. (TCE); 4) Sunflower Redevelopment, LLC v. Illinois Union Insurance Company. (PCBs and TCE); 5) Lennar Mare Island, LLC v. Steadfast Insurance Company. (PCBs and TCE).

In addition, I am frequently utilized as an expert related to Federal EPA Superfund allocations or apportionment of environmental liabilities in the context of litigation at both large and small sites. I lecture throughout the country on the topics of 1) technical approaches to divisibility and apportionment of environmental harm, and 2) allocation of environmental liabilities. For example, in 2019, I was a co-presenter for a CLE accredited webinar entitled “Marshalling the Divisibility Defense to CERCLA Liability: Apportionment – Is the Harm Distinguishable?” and presented a CLE-accredited lecture on “Environmental Forensic Tools for Establishing Divisibility.” I also co-authored an article in the Journal of Remediation in December 2019 titled “Allocating cleanup costs among potentially responsible parties.”

In addition to this expert work, I have provided broader environmental consulting services at numerous locations across the country, some locations where TCE and/or PCB releases have occurred. In this capacity, I have performed site assessments, reviewed and provided technical comments on the work of other consultants, determined the source, timing and transport of releases, evaluated site conditions in comparison to clean-up requirements, achieved regulatory closure through a “No Further Action” designation, and evaluated the standards of practice in the industry.

Testifying Appearances

My expert testifying appearances within the last 4 years are listed below.

- *Goldberg v. Goss-Jewett Company, Inc., et al.*, United States District Court, Central District of California. Case No. EDCV14-01872 DSF (AFMx). Deposition May 25, 2016; September 26, 2019. Expert Report. Rebuttal Report. Additional Rebuttal Report.
- *Von Duprin LLC v. Moran Electric Service, Inc. Major Holdings, LLC, Major Tool and Machine, Inc., and Zimmer Paper Products Incorporated.* United States District Court Southern District of Indiana, Indianapolis Division. Case No. 1:16-CV-01942-TWP-DML. Deposition June 7, 2018. Trial July 31, 2019. Expert Report.
- *King County, Washington v. Traveler's Indemnity Co., et al.* United States District Court. Western District of Washington. Case No. 14-cv-1957. Deposition April 9, 2019. Rebuttal Report.
- *Chemtronics Inc. v. Northrop Grumman Systems Corp.* American Arbitration Association Arbitration. Case No. 01-17-0007-1884. Arbitration Testimony November 12-13, 2018. Expert Report. Rebuttal Report. Supplemental Report.

- *Estate of Robert Renzel, Deceased et al. v. estate of Lupe Ventura, Deceased, et al.* United States District Court, Northern District of California. Case No. 4:15-cv-1648-HSG. Deposition August 27, 2018. Expert Declaration. Expert Report. Rebuttal Report.
- *Power Authority of the State of New York v. The tug M/V Ellen S. Bouchard, et al.* United States District Court, Southern District of New York. Case No. 14-cv-4462 (PAC). Deposition May 30, 2018. Expert Report.
- *Siltronic Corporation v. Employers Insurance Company of Wausau et al.* United States District Court, Central District of Oregon. Case No. 3:11-cv-01493-BR. Deposition May 24, 2018. Expert Report.
- *Crown Central, LLC v. Petroleum Marketing Investment Group, LLC, et al.* Circuit Court for Baltimore County, Maryland. Case No. 03-C-16-010774 CN. Deposition December 19, 2017. Expert Declaration. Rebuttal Declaration.
- *Sunflower Redevelopment, LLC v. Illinois Union Insurance Company.* United States District Court, Western District of Missouri, Western Division. Case No. 4:15-cv-00577-DGK. Deposition November 10, 2017. Rebuttal Report. Supplemental Report.
- *Insurance Company of the State of Pennsylvania v. County of San Bernardino.* United States District Court, Central District of California. Case No. 5:16-cv-00128-PSG-SS. Deposition June 15, 2017. Expert Report. Rebuttal Report.
- *Lennar Mare Island, LLC v. Steadfast Insurance Company.* United States District Court, Eastern District of California, Sacramento Division. Case No. 2:12-cv-02182-KJM-KJN. Case No. 2:16-cv-00291-KJM-CKD860. Deposition May 26, 2017. Expert Report. Supplemental Report.
- *860 Kaiser, LLC v. Greene's Cleaners, Inc.,* Napa County Superior Court. Case No: 26-63995. Deposition January 11, 2016, September 12, 2016. September 26, 2016. Expert Declaration.
- *Lewis v. Russell,* United States District Court, Eastern District of California. Case No. CIV. S-03-02646 WBS AC. Deposition July 20, 2016. Expert Report. Rebuttal Report. Supplemental Report.

Please also refer to my resume, which is attached as Exhibit A.

OPINIONS AND BASES FOR OPINIONS

OPINION 1: During Granger's lease period, 1962-1970, Granger would have used significant quantities of both PCBs and TCE in their site operations.

Granger Associates “designed, developed, and produced a wide range of products related to radio communications”¹ and was a “major supplier of communications equipment” “throughout the world.”² The “principal Granger Associates plant [was] located in Palo Alto, California at 1601 California Avenue.”³ A branch factory used for large-scale, heavy fabrication, storage, crating, and shipping was located in San Carlos, California.^{4,5}

During the period of Granger's operations, Stanford owned the property at 1601 California Avenue in Palo Alto, California. “Nokia admits that Granger Associates leased the Property from Stanford under the Ground Lease from March 1, 1962 through August 12, 1963, and that from August 12, 1963 to May 1, 1970, Granger Associates occupied the Property under a sub-lease between itself and March Haynes, the assignee of the Ground Lease.”⁶

PCBs Use in Granger Site Operations

Granger's site operations and each of Granger's transformer products involved transformer oil that would have contained PCBs. EPA has summarized information regarding PCBs in transformer oil⁷ used during the period of Grangers operations at the site:

- PCBs were “manufactured in the US under the trade name Aroclor before manufacture was prohibited by the regulations in 1979. Aroclors, which are waxes or oils, were liquefied using technical grade tri- and tetrachlorobenzenes.”⁸ “PCBs are chlorinated fire-resistant fluids that meet the definition established in the National Electrical Code (NEC) for askarel, the generic name for non-flammable synthetic chlorinated hydro-carbons used for insulating

¹ Granger Associates. Survey of General Capabilities in Engineering and Production. November 1964. Page 1. (IM_NOKIA_00029472.0002)

² Granger Associates. Survey of General Capabilities in Engineering and Production. November 1964. Page 1. (IM_NOKIA_00029472.0002)

³ Granger Associates. Survey of General Capabilities in Engineering and Production. November 1964. Page 2. (IM_NOKIA_00029472.0003)

⁴ Granger Associates. Survey of General Capabilities in Engineering and Production. November 1964. Page 3,5. (IM_NOKIA_00029472.0004;0006)

⁵ Granger Associates. Bureau of Ships Bidders List Information. August 1964. Page 2-11. (IM_NOKIA_00004229.0018)

⁶ Third Party Defendant Nokia of America Corporation's Responses to Request for Admission (Set 1) from Agilent Technologies, Inc. and HP Inc. United States District Court. Northern District of California, San Francisco Division. 3:18-CV-01199 VC. August 28, 2019. Page 7.

⁷ Note: While modern concerns and regulation of PCBs in oil are the result of PCB contamination of mineral or petroleum oils (https://www.epa.gov/sites/production/files/2018-01/documents/placeholder_for_pcb_in_used_oil_fact_sheet.pdf), askarel transformer oils used during Granger period of operations do not have mineral or petroleum oil as a component. (Oak Ridge National Laboratory. Development of a Portable Field Monitor for PCBs. Electric Power Research Institute. January 1983. Table 1-1.)

⁸ <https://www.epa.gov/sites/production/files/documents/pcbldmgmt.pdf>. Accessed Nov 8, 2019.

media.”⁹ “Askarel transformers, containing 40 to 60 percent PCBs, with the remainder of the fluid being chlorobenzenes, were manufactured in the United States from 1929 to 1978. Askarel transformers were made in a variety of sizes, containing from three to 3,000 gallons (average 235 gallons) of liquid.”¹⁰

Granger made numerous products utilizing transformer oil, and those oils would certainly have contained PCBs. When Granger occupied the site, Nokia admits they “manufactured a transmission line coupler (transformer Model 555-7) and a transmitting multicoupler (Model 520F),”¹¹ that “contained transformer oil.”¹²

- The Model 555-7 transmission line coupler was a device that coupled 600-ohm transmission lines to 50-ohm transmission lines using a balun transformer.¹³ Transformer oil was used as a “coolant” in the device and each Model 555-7 contained 12 gallons of transformer oil.¹⁴ Model 555-7 was “shipped from the factory filled with insulating oil.”¹⁵
- The Model 520F Transmitting Multicoupler was a device that coupled outputs from two transmitters, operating at different frequencies, to a single antenna.¹⁶ Transformer oil was used as a “coolant” and each Model 520F contained 27 gallons of transformer oil.¹⁷ Model 520F was shipped “oil-filled”¹⁸ and water tight.
- In addition, at least one other transformer appears to have been produced on site, as Granger described an additional product it produced as “a tunable four channel transmitting multicoupler (1. 5 kw avg power).”¹⁹

⁹ <https://www.epa.gov/sites/production/files/2013-09/documents/pcbinspectmanual.pdf>. Accessed Nov 8, 2019.

¹⁰ <https://www.epa.gov/sites/production/files/2013-09/documents/pcbinspectmanual.pdf>. Accessed Nov 8, 2019.

¹¹ Third Party Defendant Nokia of America Corporation’s Responses to Interrogatories (Set 1) from Agilent Technologies, Inc. and HP Inc. United States District Court. Northern District of California, San Francisco Division. 3:18-CV-01199 VC. August 28, 2019. Page 10.

¹² Third Party Defendant Nokia of America Corporation’s Responses to Request for Admission (Set 1) from Agilent Technologies, Inc. and HP Inc. United States District Court. Northern District of California, San Francisco Division. 3:18-CV-01199 VC. August 28, 2019. Page 15.

¹³ Granger Associates. Preliminary Technical Manual for Transmission Line Coupler (Granger Associates Transformer Model 555-7). October 1966. Page 1-1a. (IM_NOKIA_00031284.0006-7)

¹⁴ Granger Associates. Preliminary Technical Manual for Transmission Line Coupler (Granger Associates Transformer Model 555-7). October 1966. Page 2. (IM_NOKIA_00031284.0008);

¹⁵ Granger Associates. Preliminary Technical Manual for Transmission Line Coupler (Granger Associates Transformer Model 555-7). October 1966. Page 3. (IM_NOKIA_00031284.0009)

¹⁶ Granger Associates. Installation and Maintenance Manual. Model 520F. Transmitting Multicoupler. December 1967. Page 1 (IM_NOKIA_00002688.0001)

¹⁷ Granger Associates. Installation and Maintenance Manual. Model 520F. Transmitting Multicoupler. December 1967. Page 2 (IM_NOKIA_00002688.0002)

¹⁸ Granger Associates. Installation and Maintenance Manual. Model 520F. Transmitting Multicoupler. December 1967. Page 2 (IM_NOKIA_00002688.0002)

¹⁹ Granger Associates. Bureau of Ships Bidders List Information. August 1964. Page 3-3. (IM_NOKIA_00004229.0025)

Also, as part of the product design, testing, and development process, Granger's general engineering facility utilized "[p]umps and storage facilities for handling standard transformer oil."²⁰

Nokia also admits that when Granger operated the site, the site contained "a transformer (bearing City No. 4055)"²¹ for managing the facility's electrical voltage. According to site maps,²² the transformer owned and operated by the City of Palo Alto was located on the southwest side of Building I within or near the Annex. There are no reports of releases from the city transformer. Fluorescent light ballasts may have been in the facility, but they are primarily a potential indoor air hazard and contain a relatively trivial amount of PCBs.²³ Thus, neither the city transformer nor the light ballasts are reasonably expected to be a significant source, if at all, of PCBs to the observed PCB soil contamination throughout the Site.

While it is reasonable to conclude that Granger used significant quantities of PCBs in their site operations, such use did not include regulatory handling requirements or disposal restrictions for the askarel transformer oils. There is also no documentation of Granger's handling and disposal procedures related to their use of askarel transformer oils that would have prevented the release of transformer from manufacturing operations to the surrounding soil. EPA estimates that that over half of the PCBs sold in the United States were disposed of before enactment of federal regulations in 1976.²⁴

Consistent with Granger's use of PCBs in transformer oil, soil contamination at site includes both PCBs and several volatile organic compounds associated with chlorobenzenes.²⁵ The presence in soil of both PCBs and chlorobenzenes is indicative of Granger's use of askarel transformer oils containing PCBs, and that Granger is a source of PCB contamination to site soils based on their use of transformer oils.

TCE in Granger Site Operations

Granger's site operations would have extensively utilized TCE in cleaning the parts manufactured at the facility. "The use of TCE in the United States peaked in 1970, and thereafter began a significant decline due to a combination of several regulatory and economic factors."²⁶

²⁰ Granger Associates. Bureau of Ships Bidders List Information. August 1964. Page 2-13. (IM_NOKIA_00004229.0020)

²¹ Third Party Defendant Nokia of America Corporation's Responses to Request for Admission (Set 1) from Agilent Technologies, Inc. and HP Inc. United States District Court. Northern District of California, San Francisco Division. 3:18-CV-01199 VC. August 28, 2019. Page 11.

²² Birge M. Clark, Walter Stromquist, David F. Potter, Joseph Ehrlich Architects. Plot Plan-Site Details-Sheet Index-Legend & Etc., Sheet A-1. dated 4/13/62. (STAN0058619)

²³ EPA. Proper Maintenance, Removal, and Disposal of PCB-Containing Fluorescent Light Ballasts. <https://www.epa.gov/sites/production/files/documents/PCBsInBallasts.pdf>. Accessed November 26, 2019.

²⁴ National Research Council. 2001. A Risk-Management Strategy for PCB-Contaminated Sediments. Washington, DC: The National Academies Press. Pg 27. <https://www.nap.edu/read/10041/chapter/4#26>.

²⁵ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Section 2.2.1, Page 4.

²⁶ Doherty, R.H. 2000. A History of the Production and Use of Carbon Tetrachloride, Tetrachloroethylene, Trichloroethylene and 1,1,1-Trichloroethane in the United States: Part 2 - Trichloroethylene and 1,1,1-Trichloroethane. J. Environmental Forensics. 1. Page 87.

Granger's production capability included various metal fabrication steps for the equipment they manufactured, including metal working and plating.²⁷ Both metal working and metal plating require metal degreasing of the parts being handled. As an example of their degreasing operations, Nokia admits that when Granger operated the site, the site contained a "a vapor degreaser."²⁸

It is nearly certain that Granger's degreasing operations utilized TCE. "During the 1960s, TCE's combination of price and performance made it the most popular vapor degreasing solvent in the United States."²⁹ "The primary historical use of TCE is for vapor degreasing."³⁰ "TCE was found to be more advantageous than other degreasing solvents, including alkaline cleaners, because it was able to degrease a part several times faster and consume less energy in the process."³¹ Categories of degreasing that used TCE included "fabricated metal parts" and "electrical and electronic equipment."³²

Granger manufacturing operations also included printed circuit board assembly.³³ Electronics cleaning is an integral part of the production of high reliability electronics, including defluxing and other cleaning operations.³⁴ During the time Granger operated on site, TCE was commonly used for electronics cleaning related to printed circuit boards.³⁵

While it is reasonable to conclude that Granger used significant quantities of TCE in their site operations, such use did not include regulatory handling requirements or disposal restrictions for chlorinated solvents. There is also no documentation of Granger's handling and disposal procedures related to their use of TCE that would have prevented the release of TCE from manufacturing operations to the surrounding soil.

Consistent with Granger's use of TCE for cleaning operations, soil contamination at the site includes TCE. The presence of TCE within Granger's waste handling system (piping and plating

²⁷ Granger Associates. Bureau of Ships Bidders List Information. August 1964. Page 2-12. (IM_NOKIA_00004229.0019)

²⁸ Third Party Defendant Nokia of America Corporation's Responses to Request for Admission (Set 1) from Agilent Technologies, Inc. and HP Inc. United States District Court. Northern District of California, San Francisco Division. 3:18-CV-01199 VC. August 28, 2019. Page 13.

²⁹ Doherty, R.H. 2000. A History of the Production and Use of Carbon Tetrachloride, Tetrachloroethylene, Trichloroethylene and 1,1,1-Trichloroethane in the United States: Part 2 - Trichloroethylene and 1,1,1-Trichloroethane. J. Environmental Forensics. 1. Page 86.

³⁰ Morrison, R.D. and Murphy, B.L. 2013. Chlorinated Solvents: A Forensic Evaluation. RSC Publishing. Page 139.

³¹ Morrison, R.D. and Murphy, B.L. 2013. Chlorinated Solvents: A Forensic Evaluation. RSC Publishing. Page 139-140.

³² Morrison, R.D. and Murphy, B.L. 2013. Chlorinated Solvents: A Forensic Evaluation. RSC Publishing. Page 140.

³³ Granger Associates. Bureau of Ships Bidders List Information. August 1964. Page 2-12. (IM_NOKIA_00004229.0019)

³⁴ EPA. The U.S. Solvent Cleaning Industry and the Transition to Non Ozone Depleting Substances. September 2004. Page 2. <https://www.epa.gov/sites/production/files/2014-11/documents/epasolventmarketreport.pdf>. Accessed November 10, 2019.

³⁵ 1105 Seconds Street, Encinitas, California. https://www.waterboards.ca.gov/sandiego/board_decisions/adopted_orders/2017/R9-2017-0041.pdf Accessed November 18, 2019; CTS Printex site in Mountain View, California. <https://semspub.epa.gov/work/09/1126447.pdf> Accessed November 18, 2019.

sump)³⁶ and in the soil in the vicinity of Granger's solvent waste handling system³⁷ is indicative of Granger's use of TCE, and that Granger is a source of TCE contamination to site soils based on their use of TCE in various manufacturing operations.

OPINION 2: Granger's dust control and soil movement contributed PCBs and deposited PCBs throughout the site.

In addition to Granger's manufacturing operations use of PCBs as a source of PCBs to site contamination discussed in Opinion 1, other Granger activities during their lease period would have contributed PCBs to the site soils and spread contaminated soil throughout the parcel.

Granger's Direct Land Application of PCB-containing Oils

Site documents indicate Granger maintained an "oil-screened access road,"³⁸ which is reasonably expected to have resulted in PCB contamination of the soil on the parcel. Oil-screening a road, which was a common practice during the period Granger occupied the site, involves spraying oil on the bare soil surface in order to reduce the amount of dust generated. While PCBs were in some dust suppression formulations,³⁹ it is well-documented that PCB-containing used oils were extensively applied for dust suppression:

- EPA: "EPA will stop use of waste oil containing any level of PCBs for dust control. PCB-contaminated waste oil is now used extensively throughout the country to control dust on roadways, providing a direct source of environmental contamination."⁴⁰
- NOAA: "PCBs were also sprayed on dirt roads to keep the dust down prior to knowing some of the unintended consequences from widespread use."⁴¹
- National Academy of Sciences, Engineering, Medicine evaluating road dust control techniques: "Significant environmental problems can arise from the use of waste oil products."⁴²

³⁶ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Section 2.2.1, Figure 7. Samples of pipe sludge taken from locations across the original building footprint, indicating that sump piping was throughout the building and extended to the former Model Shop, which was where the Granger vapor degreaser is believed to have operated.

³⁷ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Section 2.2.1, Figure 8. Soil sampling for VOCs was focused within the original building footprint, mostly in areas near and downslope of Granger's plating sump, or in areas where piping connected to the plating sump.

³⁸ 1962 Plot Plan (STAN0012477). See also Expert Opinion of Brian Magee.

³⁹ Oregon Department of Environmental Quality. Fact Sheet: Sources of Polychlorinated Biphenyls. <https://www.oregon.gov/deq/FilterDocs/ph-SourcePCBs.pdf>. Table 2. Accessed November 10, 2019.

⁴⁰ EPA. EPA Bans PCB Manufacture; Phases Out Uses. April 19, 1979. <https://archive.epa.gov/epa/aboutepa/epa-bans-pcb-manufacture-phases-out-uses.html>. Accessed November 10, 2019.

⁴¹ <https://oceanservice.noaa.gov/facts/pcbs.html>

⁴² National Academy of Science, Engineering, Medicine. "Road dust control techniques: evaluation of chemical dust suppressants' performance" Transportation Research Board. 1996. <https://trid.trb.org/view/1205322>. Accessed November 10, 2019.

While it is undocumented what was the source of oil used for oil-screening at this Site, it is clear from the quotes above that the use of PCB-containing oils used for dust suppression was widespread. Given the time period of Granger's operations and the large volumes of PCB containing oils Granger used in the manufacturing operations, as described in Opinion 4, it is reasonably expected that, as a generator of used oil,⁴³ Granger would have had a supply of used transformer oil that would have been valuable for recycling in just such an application. While "[u]sed oil management practices of the late 1960s and early 1970s were criticized as being wasteful of a valuable resource and harmful to the environment,"⁴⁴ "oiling roads with used oil to suppress dust was considered more desirable than pure dumping or land disposal."⁴⁵ In addition to dust suppression, another known use for used oil during that time period was as a weed killer.⁴⁶ While it is undocumented what Granger used for weed suppression at the Site, any use of used transformer oil for weed suppression would have also contributed PCBs to the soils to which it was applied.

Once EPA recognized the significant risks to human health and the environments from the direct application of used oil to soils, EPA's Used Oil Management Standards banned such recycling options.⁴⁷ In 1985, EPA proposed to ban the use of used oil as a dust suppressant, and finalized the ban of all used oils for road or land application in 1992⁴⁸ – but this was after Granger's period of operations at the Site.

Consistent with Granger's expected use of used transformer oil containing PCBs for dust suppression of the oil-screened road, soil contamination at site includes both PCBs and several volatile organic compounds associated with chlorobenzenes that is indicative of Grangers use of askarel transformer oils, and that Granger is a source of PCB contamination to site soils based on their expected use of askarel transformer oil for dust and weed suppressions.

Granger's Soil Movement Spread PCB Soil Contamination

Site documents indicate, during the period of on-site manufacturing operations, Granger moved soil around the parcel as part of the building expansion and redevelopment of the facility, most specifically during its 1965 significant grading and paving operations associated with construction of parking areas and what has been referred to as temporary storage shed built in the location of Granger chemical storage area.⁴⁹ As set forth in the Expert Report of Brian Magee, any PCB impacted soil from transformer research, development, and manufacturing operations and/or direct land application of oil as a dust and weed suppressant that occurred prior to this redevelopment

⁴³ EPA. Composition and Management of Used Oil Generated in the United States. September 1984. Page 2-4.

⁴⁴ EPA. Composition and Management of Used Oil Generated in the United States. September 1984. Page 1-1.

⁴⁵ EPA. Composition and Management of Used Oil Generated in the United States. September 1984. Page 1-1.

⁴⁶ EPA. Managing Used Motor Oil. Environmental Regulations and Technology. December 1944. Page 22.

⁴⁷ EPA. Managing Used Motor Oil. Environmental Regulations and Technology. December 1944. Page 22.

⁴⁸ EPA. Recycled Used Oil Management Standards. 57 FR 41566. September 10, 1992.

<https://archive.epa.gov/epawaste/hazard/web/pdf/57fr41566.pdf>.

⁴⁹ Expert Report of Brian Magee. December 9, 2019. The Board of Trustees of the Leland Stanford Junior University vs. Agilent Technologies, Inc., and HP Inc. Case No. 3:18-CV-01199 VC.

would have been spread throughout a large segment of the parcel and is generally concurrent with where PCB soil contamination was discovered.⁵⁰

Consistent with Granger's movement of PCB impacted soil during their redevelopment and expansion of the facility, PCBs have been observed in numerous locations on the parcel where there was not transformer oil operations or expected direct land application of PCB oil, but where Site soil was moved from areas near transformer oil operations or direct land application of PCB oil. Thus, it is reasonable to conclude that the PCB soil impacts at locations not proximal to Granger's transformer oil operations or direct land application of oil are the result of the extensive soil movement undertaken by Granger, and that Granger's operations and redevelopment resulted in PCB contamination across the site.

OPINION 3: Granger released TCE to the soil below the facility as a result of its facility operations.

As addressed in Opinion 1, Granger's site operations extensively utilized TCE in degreasing the parts manufactured at the facility. Granger utilized a vapor degreaser in its Site operations⁵¹ and TCE was found within Granger's waste handling system (piping and plating sump).⁵² Based on the locations of TCE contamination observed in the soil below the facility, Granger's operations must have also released TCE into soil.

Review of plumbing plans from the 1962 construction of the "Phase I" (north/front) portion of the original site building show the location of the plating sump⁵³ and related drain piping.⁵⁴ The plans show that subslab (underground) piping connected floor drains in the plating room to the plating sump via polypropylene piping. The subslab sewer drain piping then drained southeastward to connect with a main cast iron sewer line running northeasterly out under the front of the building, with laterals from the paint room, floor drains in the main room, and other areas joining that sewer line further down-pipe. Additional subslab wastewater drain networks were located to the southeast, connected to floor drains in the main room and other facilities on the east end of the building.

In addition, the northeasterly-running cast iron sewer line draining the plating sump also captured a lateral with floor drains draining northwesterly from along the south ("rear") wall of the main room. While not shown on the 1962 plumbing plans, later documents indicate that the Model Shop room (the location of the vapor degreaser) was serviced by this lateral.⁵⁵

⁵⁰ Expert Report of Brian Magee. December 9, 2019. The Board of Trustees of the Leland Stanford Junior University vs. Agilent Technologies, Inc., and HP Inc. Case No. 3:18-CV-01199 VC.

⁵¹ Third Party Defendant Nokia of America Corporation's Responses to Request for Admission (Set 1) from Agilent Technologies, Inc. and HP Inc. United States District Court. Northern District of California, San Francisco Division. 3:18-CV-01199 VC. August 28, 2019. Page 13.

⁵² Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Section 2.2.1, Figure 7. Samples of pipe sludge taken from locations across the original building footprint, indicating that sump piping was throughout the building and extended to the former Model Shop, which was where the Granger vapor degreaser is believed to have operated.

⁵³ Note: the sump was located in the fallout shelter/storage room in the southwest corner of the building, on the south side of the wall between the fallout shelter and the plating room - not in the plating room.

⁵⁴ Birge M. Clark, Walter Stromquist, David F. Potter, Joseph Ehrlich Architects. Plumbing Floor Plan-125'-0" Level, Granger Associates Building Unit No. 1, Sheet P-2, dated 4/13/62. (STAN0129195)

⁵⁵ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017

Granger was the sole user of solvents in the plating sump and associated subslab drain pipe system.⁵⁶ In fact, the plating sump was only “rediscovered” by HP beneath linoleum flooring in 1990, where it was observed to contain only residual liquid and cobwebs.⁵⁷ While there were other sumps in the building and unrelated to Granger’s plating sump, as referenced by Lloyd Coleman and Diane Grisell/Dean Balco, those were used only for water quenching or had metal covers placed over them.⁵⁸ Nonetheless, HP investigated the plating sump and ultimately decommissioned it, receiving a No Further Action for the closure activities on May 26, 1998.⁵⁹ Documents related to the closure process state that HP had not been aware of the plating sump prior to its discovery beneath the linoleum, and had not utilized it at any point during their occupancy of the site.

In addition to Granger’s waste handling system, according to the Historical Site Features Figure of the PEA, the initial location of the chemical storage area for the Granger facility was immediately adjacent to the southeast corner of the Phase I building.⁶⁰ According to the text of the PEA, this area was part of the area in which a covered structure was built by Granger in approximately 1965.⁶¹ The details of the layout of the chemical storage area during Granger’s site operations are not known, and the chemical storage area is not shown on the original 1962 construction plans for the facility.⁶²

During the sampling for the Site’s Preliminary Endangerment Assessment (PEA) report,⁶³ TCE was widely detected in soil samples collected from soil borings within the original building (Phase I Building) footprint, with detections in most of those cases down to the total depth sampled (mostly 35 feet bgs).

The PEA described the distribution of TCE in soil as follows:

“TCE was detected in at least one soil sample at 14 of the 23 soil borings, and TCE concentrations in soil boring samples correspond to areas where TCE was detected in soil vapor (Figure 8):

- TCE was detected more frequently and at higher concentrations in deeper soil samples than shallow soil samples indicating that TCE-related impacts are more widely distributed at depth.
 - In the vicinity of the former plating sump, ...TCE was detected in soil at concentrations of 200 and 640 µg/kg at depths of 30 and 35 feet bgs; these TCE concentrations were the highest observed in soil samples collected at the Site.

⁵⁶ Environ. Underground Sump Closure Report. Hewlett-Packard Company 1601 California Avenue, Palo Alto, California. June 14, 1991. (STAN0010259)

⁵⁷ Environ. Underground Sump Closure Report. Hewlett-Packard Company 1601 California Avenue, Palo Alto, California. June 14, 1991. (STAN0010259)

⁵⁸ HP. Sump History. Interviews of Scientific Instrument Division. September 17, 1990. (AGIL0000218)

⁵⁹ SFRWQCB. No Further Action. 1601 California Avenue, Palo Alto, Santa Clara County. May 26, 1998. (AGIL0000139)

⁶⁰ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Figure 3.

⁶¹ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Pg 3. Although there are references to the structure being built in 1968, documents produced by Stanford confirm that the structure was built by Granger sometime around 1965.

⁶² HP also used that location for chemical storage until they constructed a new chemical storage area in or around 1985, but HP has documented that there were no spills or leaks during its use of that area.

⁶³ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017.

- TCE was detected in every depth sampled at borings...located at the former plating sump or former chemical storage area, where relatively coarser-grained soil was observed. The detection of TCE in soil throughout the soil column in these areas may indicate the source of TCE in the subsurface may be associated with these previous features and/or Site use. It also is possible that the relatively low concentrations of TCE detected in soil could represent TCE in equilibrium with the vapor phase at these locations.
 - At the former plating sump and associated subsurface process water lines, the highest concentrations of TCE in shallow samples (about 5 feet bgs) were observed...
 - At the former chemical storage area, TCE was detected in one shallow soil sample (about 5 feet bgs)...
- TCE was detected at depths greater than 20 feet bgs at 14 soil borings. The highest observed concentrations of TCE in soil samples collected at the Site were collected at depths of 25 to 35 feet bgs.
 - As described above, the highest TCE concentrations detected in soil were at locations...advanced in the vicinity of the former plating sump.
 - Approximately 250 feet northeast of the former plating sump, ...TCE was detected at a concentration of 180 µg/kg at 25 feet bgs. At this boring, concentrations of TCE attenuated toward the surface, and TCE was not detected at 5 feet bgs."

Thus, the plating sump and associated subslab drain pipe system has been well-documented as the most likely site source of TCE in the subsurface of the Site. The conceptual site model (CSM) in the PEA⁶⁴ provided an overview of the implications of all investigation findings, including a summary of what the distribution of VOCs in the subsurface indicated was the likeliest source for those VOCs. Based on that, the CSM stated:

"...the plating sump appears to be a primary source of TCE in soil vapor. In addition to this source area, the former chemical storage area may be an additional source area. However, there is no documentation of chemical releases from the chemical storage area, located immediately south of the Phase I building." ⁶⁵

Thus, Granger's operations involving TCE are clearly connected with the TCE soil contamination at the Site through releases from the sump and subslab piping system.

OPINION 4: During HP/Agilent 's lease period, 1970-2005, they did not use PCBs and used TCE for only a short period (1971-1977), and neither

⁶⁴ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017.

⁶⁵ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Sections 8.1 and 8.2, pg 32-33.

accounts for a material portion, if any, of PCB or TCE conditions found at the Site.

Both HP and Agilent used the facility for “manufacture, assembly, and calibration of electronic analytical instruments.”⁶⁶ For example, Geomatrix reported that Agilent “performed research and development for the manufacture of gas chromatograph/mass spectrometry (GC/MS) and liquid chromatography equipment.”⁶⁷

During the period of HP’s operations, Stanford owned the property at 1601 California Avenue in Palo Alto, California. HP subleased the Property from Granger in 1970⁶⁸ and was assigned the lease by Elwood Hayes in 1983.⁶⁹ During the period of Agilent’s operations, Stanford owned the property at 1601 California Avenue in Palo Alto, California. HP assigned the lease to Agilent at the end of 1999.⁷⁰ Agilent vacated the building in December 2002⁷¹ and ceased operations at the facility in early 2003.⁷² Agilent agreed to terminate the lease, through an Option and Purchase Agreement with Stanford, which closed at the end of 2005.⁷³

In 1990, HP reported the chemical use history of its operations to the California Regional Water Quality Control Board.⁷⁴ This chemical use history did not list PCBs as being used at anytime. The chemical use history did report the use of TCE in the time frame of 1971 to 1977, estimated at 400 gallons per year. No TCE is listed in the chemical use history after 1977, as HP began using alternative solvents to TCE.

PCB Use in HP/Agilent Operations

Neither HP nor Agilent has documented PCB use related to their facility operations in the design, manufacture, assembly, and calibration of electronic analytical instruments. Based on the types of activities performed in the design, manufacture, assembly, and calibration of electronic analytical instruments, it is not expected that PCBs would have been part of those manufacturing processes.

Similar to Granger, HP/Agilent utilized a city transformer for managing the facility’s electrical voltage. According to site maps, the transformer owned and operated by the City of Palo Alto was located on the southwest side of Building I within or near the Annex. There are no reports of releases from the city transformer. Fluorescent light ballasts had been in the facility, but they are primarily a potential indoor air hazard and contain a relatively trivial amount of PCBs.⁷⁵ Neither the

⁶⁶ Haley Aldrich. Preliminary Endangerment Assessment. 1601 S. California Avenue, Palo Alto, California. October 2017. Page 3.

⁶⁷ Geomatrix. Soil Vapor, Soil, and Groundwater Investigation Report. 1601 California Avenue, Palo Alto, California. September 2004. Page 5. (STAN0003781)

⁶⁸ Assignment of Sublease. May 1, 1970. (AGIL0022670)

⁶⁹ Amendment, Assignment, Assumption and Consent to Assignment of Lease. February 11, 1983. (STAN0018741)

⁷⁰ Assignment of Lease. October 22, 1999 (AGIL0022740); Assignment and Assumption of Lease. August 26, 1999 (STAN0017817)

⁷¹ Geomatrix. Soil Vapor, Soil, and Groundwater Investigation Report. 1601 California Avenue, Palo Alto, California. September 2004. Page 4. (STAN0003780)

⁷² ERM. Post-Closure Report. Building B-17 1601 California Avenue, Palo Alto, California. July 2004. Page 1. (AGIL007401)

⁷³ Option and Purchase Agreement. May 20, 2004. (STAN0018773)

⁷⁴ HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. (AGIL0007095)

⁷⁵ EPA. Proper Maintenance, Removal, and Disposal of PCB-Containing Fluorescent Light Ballasts. <https://www.epa.gov/sites/production/files/documents/PCBsInBallasts.pdf>. Accessed November 26, 2019.

city transformer nor the light ballasts area reasonably expected to be a source of PCBs to the observed PCB soil contamination throughout the Site.

Soon after HP/Agilent leased the property, PCB use was greatly curtailed and ultimately banned in 1979. “In 1971 Monsanto voluntarily restricted manufacturing of PCBs to use only in closed systems. Monsanto discontinued manufacture of PCBs in 1977, though PCBs continued to be imported into the U.S. until 1979 when the U.S. ban took effect.”⁷⁶

Thus, the lack of PCB use in manufacturing operations, the expected trivial ancillary use of PCBs at the facility in light ballasts, and the curtailing and banning of PCB use in the early years of HP/Agilent operations on Site, indicates HP/Agilent operations was not a contributing source of PCBs to site soil contamination.

TCE Use in HP/Agilent Operations

As discussed above, TCE was used by HP from 1971-1977.⁷⁷ HP considered its operations to be a “small generator of hazardous wastes.”⁷⁸ Also, “[b]ased on employee interviews, document research and handling practices, no known releases or spills of chemicals into the ground occurred since HP has occupied the facility”⁷⁹ Nor is there any evidence of such releases or spills.

During the limited time HP used TCE, chemical storage was in the same location that Granger used for chemical storage, “in cabinets under a metal roof enclosure next to the main building.”⁸⁰ HP reported that during this time, “hazardous wastes were collected in a 250-gallon above ground tank next to the back of the main building and shipped off-site for disposal.”⁸¹ In 1985, as part of the Building 17 expansion, a new chemical storage building was constructed on-site.⁸²

Thus, while HP handled and disposed of TCE as part of its early site operations, there is not a clear release mechanism for the TCE used by HP to have been released to the underlying soil: no operational process releases, no reported spills, no indication improper waste disposal. Only the TCE soil contamination in the vicinity of the original chemical storage area used by HP, originally used by Granger also, matches an area where HP’s TCE handling was known. Nonetheless, there is no basis to suggest that HP’s operations on the site contributed to TCE soil contamination since there is no evidence of any spill or release during HP’s time on the site, and alternatively, Stanford’s consultant concluded that the sump was the primary site source of TCE.⁸³

⁷⁶ <https://www.oregon.gov/deq/FilterDocs/ph-SourcePCBs.pdf>. Accessed November 10, 2019.

⁷⁷ HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. (AGIL0007095)

⁷⁸ HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. Page 4 (AGIL0007098)

⁷⁹ HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. Page 4 (AGIL0007098)

⁸⁰ HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. Page 3 (AGIL0007097)

⁸¹ HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. Page 3 (AGIL0007097)

⁸² HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. Page 3 (AGIL0007097)

⁸³ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Sections 8.1 and 8.2, pg 32-33.

OPINION 5: HP/Agilent did not cause significant expansions of PCBs impacts at the site Both HP

As discussed in Opinion 4, given the lack of any PCB handling by HP in its manufacture, assembly, and calibration of electronic analytical instruments and trivial ancillary PCB presence at the facility in the city transformer and light ballasts, HP/Agilent did not make a direct contribution to PCB contamination in Site soil.

In fact, soon after HP/Agilent leased the property, PCB use was greatly curtailed and ultimately banned in 1979. “In 1971 Monsanto voluntarily restricted manufacturing of PCBs to use only in closed systems. Monsanto discontinued manufacture of PCBs in 1977, though PCBs continued to be imported into the U.S. until 1979 when the U.S. ban took effect.”⁸⁴

As set forth in the Expert Report of Brian Magee, while HP’s facility redevelopment required excavation of soil from an embankment on the site and rough, superficial grading after the concrete and other improvements made by Granger were demolished, it was not necessary for HP to conduct significant soil movement across any areas of the Site because Granger had effectively graded the entire footprint of what would become Building 17 and its surrounding improvements. Therefore, any soil movement performed by HP during its redevelopment did not significantly redistribute PCB-contaminated soils. Moreover, any soil HP may have moved was generally the same footprint that has been previously moved by Granger in previous facility modifications.⁸⁵ In other words, any movement of PCB soils that may have occurred simply would have moved them to areas in which PCB soils were already present as a result of Granger’s prior excavation, grading, and paving in the 1960s. Therefore, HP’s soil movement related to its facility redevelopment did not result in a material geographic expansion of PCB soil contamination at the site.

OPINION 6: HP/Agilent’s environmental impacts from use of TCE in their operations are reasonably expected to be insignificant.

While HP reported that it utilized TCE in its operations from 1971-1977,⁸⁶ there is no evidence of any releases from HP operations during that time period. As addressed in Opinion 6, the primary source of TCE in the subsurface soil is well-documented to be the plating sump⁸⁷ and associated

⁸⁴ <https://www.oregon.gov/deq/FilterDocs/ph-SourcePCBs.pdf>. Accessed November 10, 2019.

⁸⁵ Expert Report of Brian Magee. December 9, 2019. The Board of Trustees of the Leland Stanford Junior University vs. Agilent Technologies, Inc., and HP Inc. Case No. 3:18-CV-01199 VC.

⁸⁶ HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. (AGIL0007095)

⁸⁷ The documentary record for this site includes references to several sumps, references to which are frequently non-specific and confusing. Sumps have been identified at this Site as follows:

1. The sump of primary interest is the plating sump or dilution tank. Located adjacent to Granger’s plating room in the fallout shelter in northwest corner of the original (Phase I) building, this feature is the sump discovered beneath linoleum by HP and subsequently decommissioned in 1991, as reported by ENVIRON, with regulatory closure received in 1998. The PEA indicates that the plating sump and associated piping are the primary source of TCE in the subsurface at the Site.
2. Four subgrade containment sumps were part of the stand-alone chemical storage located east of the building and constructed by HP in the mid-eighties. These are the sumps that the PEA specifically indicates were not an apparent source of TCE impacts.
3. The history of any sump or sumps at the original chemical storage area at the rear of the Phase I building is less clear. While specific details are very limited regarding the configuration of this area during Granger’s tenancy, what

subslab piping, utilized solely by Granger. HP had not been aware of the plating sump prior to its discovery beneath the floor, and had not utilized it at any point during their occupancy of the site.⁸⁸

HP did not dispose of its liquid waste in sumps like Granger, but instead “hazardous wastes were collected in a 250-gallon above ground tank next to the back of the main building and shipped off-site for disposal.”⁸⁹ Instead of the using the wastewater piping system plumbed through the plating sump as Granger had done, HP had an above-grade process wastewater system within the building and double contained piping underground. A 1990 letter from HP to the Water Board describes this system at that time, stating that “Process waste water from fume hoods and laboratory sinks are pumped to holding tanks in the chemical storage building for testing prior to disposal into the City sewer system. The process waste water pipe is double contained and runs underground beneath

information is available appears to indicate that secondary containment or similar sumps were not present at that time in that area. During HP’s use of that area, prior to the construction of the stand-alone chemical storage building to the east of the main building in the mid-eighties, some secondary containment features, including drain trenches and one or more sumps, were apparently in use. A hand drawn figure showing the layout of chemical storage in that area is available; a sump or sumps are shown on the periphery of that drawing.

4. A July 2004 Phase I Environmental Site Assessment (ESA) report conducted by Geomatrix on behalf of Stanford includes notes regarding a “possible sump area” located “between the newer and older buildings”, apparently on the west side of the building in close proximity to the location of the electrical transformer. This feature is shown on Figure 3 and in the photo log of the 2004 Phase I ESA report, but is not discussed in the text of that report. The photos show a metal grate apparently covering a subgrade feature immediately adjacent to the rear of the transformer. As the Report and subsequent investigations make no additional reference to this feature, and given its proximity to the transformer, it does not appear that this feature was a sump for managing liquids, but instead may have been a utility vault related to site electrical infrastructure.
5. The July 2004 Phase I ESA report photo log also includes a photo of a “Process Waste Water Pump Vault on the west side of the newer building”. This feature is also not discussed in the text of that report. The HP-17 Site Utilities Plan attached to the 2017 PEA shows a “Pressure Reducing Valve in Vault” at the southwest corner of the newer portion of the building, adjacent to the cafeteria, in an area where several utility lines converge. The function of this valve/vault is not known. However, as the Phase I ESA Report and subsequent investigations including the PEA make no additional reference to any process wastewater management features in this area, and the utility plan shows no evidence of this vault being plumbed to the chemical storage shed (as other process wastewater pipes were within the older part of the building), it is not clear that this vault was in fact part of the process wastewater system. In any case, as subsequent investigations did not focus on this feature, it does not appear that this vault was of ongoing environmental concern.
6. Interviews conducted on September 17, 1990 with former HP Materials and Shipping Manager Lloyd Coleman and Welders Diane Grisell and Dean Balco also include reference to sumps. The descriptions are unclear as to whether one or more sumps are being discussed in the interviews. The Coleman interview makes note of a sump located in a shipping room that was treated for mosquito abatement around 1980-1981. The interview also notes that Mr. Coleman recollected that when HP first occupied the site in 1971, there were redwood planks over a sump located in the floor of the Weld Shop, with HP subsequently replacing the planks with metal grating, using the sump to quench hot metal parts in water. The Welders also referenced quenching hot parts in a system that “drained into the floor drains which lead into the sump on the other side of the wall.” It is not clear from the descriptions if the weld shop quenching sump, the sump that was covered with redwood planks, and the sump in the shipping room which was treated for mosquitoes are the same sump. Regardless, it seems that the sumps referenced in the interviews were obviously known to HP, which according to the ENVIRON plating sump closure report was not the case for the plating sump/dilution tank that had just then been discovered in August of 1990 under linoleum in the Kitting Room. In any case, none of these sumps (including the plating sump) were ever utilized by HP for managing solvent-containing wastewater.
7. Various other features at the site were also intermittently referred to as sumps, including assorted subgrade utility and pump vaults, and piping and other equipment related to the historic diesel and fire water storage tanks located west of the Phase I building. Features such as these are not of ongoing environmental concern, but references to them can be confounding in review of the documentary record.

⁸⁸ Environ. Underground Sump Closure Report. Hewlett-Packard Company 1601 California Avenue, Palo Alto, California. June 14, 1991. (STAN0010259)

⁸⁹ HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. (AGIL0007095)

the shipping service yard. The process waste water is mostly detergent and water from cleaning and rinsing operations. This process waste water testing system was installed to prevent discharges of accidental spills of solvents or acids into the City sewer system.”⁹⁰

HP’s Site Utilities Plan in Appendix A of the PEA shows the location of the piping for HP’s process wastewater piping system.⁹¹ Since HP did not use Granger’s sump or subgrade piping system, and there is no record that HP installed new subgrade waste in the facility, HP appears to have handled its solvent waste generation above grade within the building. The HP wastewater piping system extended southeasterly from process wastewater pumps located inside the east and west ends of the Phase I site building to pipes running across the rear (south) of that building, exiting the building at the southeast corner. According to a 1987 Site Utilities Plan, outside the building the pipes continued to the southeast, and in concordance with the 1990 letter were noted as underground and double-contained, extending to process wastewater tanks located inside the south end of the chemical storage building to the southeast. Inside the building, the HP Site Utilities Plan does not explicitly note the process wastewater pipes are above grade, however, the process wastewater pumps are not noted as being in vaults, as a noted for other utilities (gas, water). Thus, the lack of any indication that the wastewater piping is below grade on the utility plan (intended to mark such utilities) indicates that the interior portions of the HP wastewater handling system would have been located above the floor slab.

Prior to 1985, which included the 1971-77 interval during which HP used TCE, HP stored hazardous chemicals and waste in the original hazardous materials storage area in same location used by Granger, at the southeast corner of the original Phase I building.⁹² While TCE was detected in the subsurface in the vicinity of the original chemical storage area, the PEA suggests the TCE observed in the vicinity could reasonably be expected to be the migration of TCE from the plating sump.

- *“At the location of the former chemical storage area...TCE was detected at relatively high concentrations in soil vapor...The former chemical storage may represent a second source area, or TCE may have migrated via preferential pathways from the former plating sump to this area.”*⁹³

In fact, the PEA states “there is no documentation of chemical releases from the chemical storage area, located immediately south of the Phase I building”⁹⁴ and moreover, HP concluded that “[b]ased on employee interviews, document research and handling practices, no known releases or spills of chemicals into the ground occurred since HP has occupied the facility.”⁹⁵

While HP reported that “Prior to the construction of the...[stand-alone] chemical storage building [to the east], fuel oils, thinners, Freon 113, 1,1,1-trichloroethane, laboratory chemicals and compressed gas cylinders were stored on racks or in cabinets under a metal roof enclosure next

⁹⁰ HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. (AGIL0007095)

⁹¹ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Appendix A, Historical Documents, “HP-17 Site Utilities Plan”

⁹² HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. (AGIL0007095)

⁹³ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017.

⁹⁴ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Sections 8.1 and 8.2, pg 32-33.

⁹⁵ HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. Page 4 (AGIL0007098)

to the main building,⁹⁶ these other chemicals stored by HP were not observed in soil samples,⁹⁷ and were only intermittently detected in soil vapor.⁹⁸ While acetone, TCA, and Freon 113 were detected in soil gas in the vicinity of the original chemical storage area, they were discovered at very low concentrations, such that none of the detections of these compounds in soil vapor were above screening criteria, or above current Tier 1 (Residential) Environmental Screening Levels (ESLs). Thus, it is not reasonable to assume HP released a significant amount of TCE in the vicinity of the original chemical storage area, yet somehow avoided releasing significant quantities of any of the other chemical that had been used in greater volumes per year and for longer durations.⁹⁹

HP constructed a stand-alone chemical storage building located east of the primary building in approximately 1985.¹⁰⁰ From that time until HP/Agilent vacated the site, the process wastewater system was plumbed to tanks with secondary containment sumps located at that chemical storage building¹⁰¹. Consistent with HP's absence of TCE in the operations after 1977, the PEA explicitly indicates that this chemical storage area located east of the Phase I building was confirmed not to be a source of TCE.

- *"In addition, it is important to note the location of four historical sumps in the Chemical Storage Building (located east of the Phase I building) were evaluated as a potential source area. TCE was not detected in shallow soil vapor samples collected at this area...These results, and the lack of observed impacts to shallow soil during the removal of the concrete slab at this area, indicate that a release is unlikely to have occurred from these sumps."*¹⁰²

The records of chemical storage and handling by HP/Agilent indicate that the impacts to the site from the use of TCE, if any, are reasonably expected to be insignificant. Broadly, environmental investigation findings did not indicate any TCE impacts in the subsurface in the areas primarily utilized by HP/Agilent for chemical storage and handling, and risk assessments conducted for the PEA indicated that most areas utilized by HP/Agilent did not specifically require remediation (with the exception of the vicinity of the original Granger chemical storage area formerly located at the rear of the Phase I building).¹⁰³ Further, VOCs other than TCE, including 1,1,1-trichloroethane (TCA) and other compounds which were utilized in greater quantities and for a longer period of time by HP/Agilent, were not detected in site soils above screening criteria, indicating that VOC

⁹⁶ HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. (AGIL0007095)

⁹⁷ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Soil Summary

⁹⁸ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Soil Gas Summary.

⁹⁹ HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. Page 4 (AGIL0007098) Acetone: 400+ gal/yr, 1971-1989; Isopropanol (IPA): 300+ gal/yr, 1971-1989 (Note that IPA was also used as "solder/flux thinner", and inventoried separately from 1978-1989; 100+ gal/yr or less); Methanol: 200 gal/yr, 1971-1984; <30 gal/yr, 1985-1989; TCE: 400 gal/yr, 1971-1977. PCE: 200 gal/yr, 1978-1979; TCA: 400 gal/yr, 1980-1989; Freon 113: 200 gal/yr, 1978-1979; >400 gal/yr, 1980-1989.

¹⁰⁰ HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. (AGIL0007095)

¹⁰¹ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017.

¹⁰² Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Section 8.1 pg 32

¹⁰³ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Section 8.1 pg 29-31

impacts in all areas, including in the area of the former chemical storage area, attributable to Granger's operations, rather than those of HP/Agilent.

OPINION 7: The PCB and TCE soil impacts are divisible between Granger and HP/Agilent.

There is no evidence that supports the idea that HP/Agilent's operations had any substantial contribution to the PCB or TCE site contamination. Nonetheless, assuming for argument sake scenarios that include some significant HP/Agilent's contribution to Site contamination, divisibility of the contamination among Granger and HP/Agilent is possible based on the geographic, chemical, temporal, and/or volumetric characteristics associated with each of their shares of contamination. It is important to note that the Supreme Court has established that the threshold for divisibility is that it need not be precise, only that there are "facts contained in the record reasonably support[ing] the apportionment of liability."¹⁰⁴

I evaluated the divisibility of only PCB and TCE site impacts, since these are the only COC driving any remedial action. Based on my evaluation, PCB and TCE contamination at the site is divisible, and cannot under any plausible scenario be solely, or even substantially, attributed to HP/Agilent's operations from 1970 to 2005.

Divisibility of PCB Contamination relative to TCE Contamination

The chemical distinction between PCBs and TCE enable the geographic area of contamination for PCBs and TCE to be readily bounded based on the Site Investigation data. Thus, the PCB and TCE contamination are readily divisible based on the differing geographic extent shown in the PEA.¹⁰⁵

Divisibility Between Granger and HP/Agilent of PCB Contamination

Virtually all the PCB contamination at the Site was characterized as Aroclor 1260.¹⁰⁶ Of the over 250 soils samples measured for PCBs, only 2 samples (both from Tree Root Zones), has detectable levels of PCBs other than Aroclor 1260 (Aroclor 1254). All other PCB detections on Site were Aroclor 1260. Over 50 samples were measured with Aroclor 1260 concentrations above the Residential RSL, whereas only 2 samples were measured with Aroclor 1254 concentration above the Residential RSL. Thus, greater than 95% of all the Site PCB contamination above Residential RSLs is attributable to Aroclor 1260.

As discussed in Opinion 1, Granger used large volume of askarel transformer oils in its manufacturing operations and devices, which contain Aroclor 1260. Beginning in 1932, the use of askarels transformer oil was widespread through the use of General Electric Company product

¹⁰⁴ BNSF, 129 S. Ct. 1870, 1881 (2009).

¹⁰⁵ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Figures 9, 10, 12

¹⁰⁶ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. APPENDIX D. Tabulated Pre-Excavation Soil Sample Results – PCBs

Pyranol 1499, followed by Westinghouse's Inerteen in 1936.¹⁰⁷ Askarel liquid insulation is made by thinning Aroclor 1260 with trichlorobenzene or tri, tetrachlorobenzene mix.¹⁰⁸ The composition of askarel transformer oil is shown below in Table 10-1.

COMPOSITION OF TRANSFORMER MATERIALS

	Pyranol				Inerteen	Inerteen PPO (7336-9)
	<u>1488</u>	<u>1467</u>	<u>1470</u>	<u>A13B3B</u>		
Year introduced	1932	1944	1952	1963	1936	1945
<u>Ingredients (wt %)</u>						
Aroclor 1260	60	60	45	45	60	60
Trichlorobenzene	40	40	40	40	40	40
Tetrachlorobenzene			15	15		
Tin tetraphenyl		0.125	0.125			
Phenoxy propene oxide						0.20
Diepoxide				0.125		

Table 7-1. Chemical composition of askarel transformer oil.¹⁰⁹

As shown above, several alterations of askarel transformer oil formulations were made in the 1940s. Tin tetraphenyl, phenoxy propene oxide, and a diepoxide were added as hydrogen chloride scavengers.¹¹⁰ The two commercial types of askarel transformer oil formulations when Granger operated were General Electric 1s Transformer Pyranol A13B3B type and Westinghouse Inerteen PPO (7336-9) type.¹¹¹

As discussed in Opinion 4, there is no documented HP/Agilent PCB use related to their facility operations. More so, prior to 1971, the Monsanto Chemical Company produced Aroclors 1221, 1232, 1242, 1248, 1254, 1260, 1262, and 1268; however, in 1971, the company voluntarily restricted the uses of PCBs and subsequently produced only Aroclor 1016, 1242, 1254, and small quantities of Aroclor 1221.¹¹² Therefore, Aroclor 1260 was not even available for use in manufacturing operations during the time period of HP/Agilent Site operations. Furthermore, in

¹⁰⁷ Oak Ridge National Laboratory. Development of a Portable Field Monitor for PCBs. Electric Power Research Institute. January 1983. Page 1-1.

¹⁰⁸ Oak Ridge National Laboratory. Development of a Portable Field Monitor for PCBs. Electric Power Research Institute. January 1983. Page 1-2.

¹⁰⁹ Oak Ridge National Laboratory. Development of a Portable Field Monitor for PCBs. Electric Power Research Institute. January 1983. Table 1-1.

¹¹⁰ Oak Ridge National Laboratory. Development of a Portable Field Monitor for PCBs. Electric Power Research Institute. January 1983. Page 1-2.

¹¹¹ Oak Ridge National Laboratory. Development of a Portable Field Monitor for PCBs. Electric Power Research Institute. January 1983. Page 1-2.

¹¹² Agency for Toxic Substances and Disease Registry. Production, Import/Export, Use, and Disposal. Pg 467-468. <https://www.atsdr.cdc.gov/toxprofiles/tp17-c5.pdf>

1978, EPA began to regulate the storage and disposal of all PCBs,¹¹³ and by 1979 had banned the manufacture of new any PCB electrical equipment.¹¹⁴

Also, some of the ancillary uses of PCB-containing equipment/devices that could plausibly been used by HP/Agilent, like fluorescent light ballasts or capacitors or vacuum pumps, would not have contained PCBs with Aroclor 1260.

Table 5-1. Summary of Former End Uses for Various Aroclors

End use	Aroclor								
	1016	1221	1232	1242	1248	1254	1260	1262	1268
Capacitors	•	•				•			
Transformers				•		•	•		
Heat transfer				•					
Hydraulics/lubricants									
Hydraulic fluids			•	•	•	•	•		
Vacuum pumps					•	•			
Gas-transmission turbines		•		•					
Plasticizers:									
Rubbers		•	•	•	•	•			•
Synthetic resins					•	•	•	•	•
Carbonless paper				•					
Miscellaneous:									
Adhesives		•	•	•	•	•			
Wax extenders				•		•			•
Dedusting agents						•	•		
Inks						•			
Cutting oils						•			
Pesticide extenders						•			
Sealants and caulking compounds						•			

Table 7-2. Summary of Former End Uses for Various Aroclors¹¹⁵

Thus, based on the chemical uniqueness of Aroclor 1260 used solely by Granger, 100% of the Aroclor 1260 contamination is divisible to Granger – which is greater than 95% of all the PCB soil contamination.

In addition to Aroclor 1260, there were two detection of Aroclor 1254 on the Site.¹¹⁶ While these detection were in the Tree Root Zone, PCB concentrations were above the remediation goal established for the Site, the trees were designated for removal and appropriate disposal as part of

¹¹³ Agency for Toxic Substances and Disease Registry. Production, Import/Export, Use, and Disposal. Pg 473. <https://www.atsdr.cdc.gov/toxprofiles/tp17-c5.pdf>

¹¹⁴ EPA. EPA Bans PCB Manufacture; Phase Out Uses. Press Release. April 19, 1979. <https://archive.epa.gov/epa/aboutepa/epa-bans-pcb-manufacture-phases-out-uses.html>

¹¹⁵ Agency for Toxic Substances and Disease Registry. Production, Import/Export, Use, and Disposal. Pg 467-468. <https://www.atsdr.cdc.gov/toxprofiles/tp17-c5.pdf>

¹¹⁶ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Table D-4.

the soil removal program.¹¹⁷ Thus, some soil removal was required as a result Aroclor 1254 contamination.

The source of Aroclor 1254 at the Site is unknown. The only direct connection with Site activities to Aroclor 1254 is from the City of Palo Alto maintained a transformer (No. 4055).¹¹⁸ This City owned transformer was retrofitted by the City to non-askarel transformer oil¹¹⁹ sometime prior to 1985. Measurements of the mineral oil-based transformer oil detected low concentrations Aroclor 1254. The Aroclor 1254 concentration in the transformer oil were at 190 ppm in 1984 and decreased to 16 ppm after the oil was changed out in 1985¹²⁰ - below the concentrations observed in the Tree Root Zone.¹²¹ There were no reports of releases of from the City maintained transformer.

As Table 7-2 shows, in addition to City's transformer oil, there are numerous other end uses that utilized Aroclor 1254. The end uses for Aroclor 1254 could have been part of Granger or HP operations. Thus, the Aroclor 1254 contamination is not divisible between Granger and HP – or other potential contributors of Aroclor 1254. Thus, there is no evidence that supports the idea that HP/Agilent's operations had any substantial contribution to the PCB site contamination. Nonetheless, assuming scenarios where it is at least plausible that HP/Agilent's contributed to Site contamination, its contribution to PCB site contamination would be less than 5%.

The degree to which soil movement during redevelopment activities contributed to the expansion of site PCB contamination is also divisible. As discussed in the Expert Report of Brian Magee, Opinion 2 and Opinion 5, it was primarily Granger's activities that moved soil to different parts of the site. In contrast, the areas in which HP performed its redevelopment activities was within the areas with soil that was likely previously contaminated with PCBs from Grangers operations, and any soil that HP may have moved was generally within the same footprint that has been previously moved by Granger in Granger's previous facility modifications. Based on a temporal analysis of the various phases of earthwork at the Site, HP's earthwork did not contribute to a significant expansion of the previous PCB contamination at the Site, and to the extent there may have been limited, discrete area where HP moved contaminated soil to previously uncontaminated areas, those areas are divisible from Granger's prior and essentially site-wide expansion of PCB contaminated soils.

Divisibility Among Granger and HP/Agilent of TCE Contamination

Both Granger and HP used TCE in their Site operations, so the consideration of contributions to Site TCE contamination includes both operators. In contrast to the PCB Site contamination, there is no information that enables chemically distinguishing the TCE molecules released by Granger from that of HP.

¹¹⁷ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Page 24.

¹¹⁸ Third Party Defendant Nokia of America Corporation's Responses to Request for Admission (Set 1) from Agilent Technologies, Inc. and HP Inc. United States District Court. Northern District of California, San Francisco Division. 3:18-CV-01199 VC. August 28, 2019. Page 11.

¹¹⁹ HP. Electrical Transformer memo. October 3, 1985. (AGIL0007048)

¹²⁰ HP. Electrical Transformer memo. October 3, 1985. (AGIL0007048)

¹²¹ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Table D-4.

TCE site impacts are the result of the direct release of TCE to site soils. There are only two areas that were identified as requiring remediation, the area in the vicinity of the plating sump/piping system in the Phase I Building and the original chemical storage area. Redistribution of TCE contaminated soil as part of site redevelopment activities did not result in any identified spread of TCE contamination that required cleanup. These two areas of TCE contamination are geographically divisible and, therefore, the contributors to each geographically distinct area can be evaluated independently.

As discussed in Opinion 3 and 6, Granger was the only user of the plating sump/piping system in the Phase I Building. Thus, based on the geographic uniqueness of Granger's TCE operations utilizing the plating sump/piping system, 100% of the TCE contamination in the Phase I Building footprint is divisible to Granger.

Both Granger and HP used the original chemical storage area, so there is no geographic divisibility for Granger's and HP's contribution to TCE contamination in the original storage area. Although, there are some divisibility considerations based on reasonable surrogates of the volume contributed.

- While the PEA states "there is no documentation of chemical releases from the chemical storage area, located immediately south of the Phase I building", ¹²² in fact, Granger never reported whether or not there was releases or spills in the original chemical storage area. Whereas, HP previously concluded that "[b]ased on employee interviews, document research and handling practices, no known releases or spills of chemicals into the ground occurred since HP has occupied the facility." ¹²³ Thus, the degree to which releases and spills occurred during Granger's operations would increase the volume of Granger's TCE contribution.
- The PEA suggests that original chemical storage area is an extension of contamination from the sump/piping system, ¹²⁴ which is 100% attributable to Granger sole operations of the sump/piping system. Thus, any volume contribution from the extension of contamination from the sump/piping system would increase the volume of Granger's TCE contribution.
- As discussed in Opinion 6, HP reported that other VOC chemicals were stored in the original chemical storage area, these chemicals were not observed in soil samples, ¹²⁵ and were only intermittently detected in soil vapor at low concentrations. ¹²⁶ Considering that it is not reasonable to assume HP released a significant amount of TCE in the vicinity of the original chemical storage area, yet avoided releasing significant quantities of any of the other chemical that had been used in greater volumes per year and for longer durations, ¹²⁷ the volume of HP's TCE contribution in the original storage area was likely not significant.

¹²² Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Sections 8.1 and 8.2, pg 32-33.

¹²³ HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. Page 4 (AGIL0007098)

¹²⁴ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017.

¹²⁵ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Soil Summary

¹²⁶ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Soil Gas Summary.

¹²⁷ HP. Request for Chemical Use History for 1601 California Avenue, Palo Alto, Building 17. January 12, 1990. Page 4 (AGIL0007098) Acetone: 400+ gal/yr, 1971-1989; Isopropanol (IPA): 300+ gal/yr, 1971-1989

While a precise calculation of the volume of TCE contributed by Granger and HP is not possible, the facts above reasonably support the divisibility of TCE contribution in the original chemical storage area, such that there is a significantly larger volume contribution of TCE from Granger's operations than from HP's operations.

OPINION 8: Given the divisibility of the contamination between Granger and HP/Agilent, the average apportionment of contamination between Granger and HP/Agilent is approximately 94% for Granger (89%-98%) and 6% for HP/Agilent (2%-11%).

There is no evidence that supports the idea that HP/Agilent's operations had any substantial contribution to the PCB or TCE site contamination. Nonetheless, assuming scenarios where it is at least plausible that HP/Agilent's contributed to Site contamination, an apportionment among Granger and HP/Agilent is possible based on the divisibility discussed in Opinion 7. Again, the Supreme Court has established that divisibility and apportionment need not be precise, only that there are "facts contained in the record reasonably support[ing] the apportionment of liability."¹²⁸

In order to apportion among Granger and HP/Agilent, I apportioned only contributions to PCB and TCE site impacts, since these are the only COC driving any remedial action. Based on the geographic extent of PCB contamination compared to TCE contamination,¹²⁹ I apportioned 70%-90% of the overall site impact to PCBs and 10%-30% of the overall site impact to TCE.

PCB Site Impact Apportionment

PCB site impacts are the combined result of the direct release of PCBs to site soils and the redistribution of PCB contaminated soil as part of site redevelopment activities. Since the soil redistribution would not have cause any harm without the initial release of PCBs into the soil, I divided the 70%-90% of the overall PCB harm into a 50%-70% resulting from direct contribution and 20% share resulting from soil redistribution.

The chemical divisibility of the direct PCB contamination, based on the virtually all PCB site contamination being identified as Aroclor 1260, indicate the original source of the PCB soil contamination at the site was from Granger's use of askarel transformer oil, including land application of such oils. The source of the relatively trivial amount of Aroclors 1254 detected in site soil is unknown and there is no indication of Aroclor 1254 contribution of HP/Agilent. Assuming a scenario where there is an HP/Agilent contribution to the Aroclor 1254 contamination, and the easily established chemical divisibility, 95%-100% of the direct PCB contamination is apportioned to Granger and 0%-5% is apportioned to HP/Agilent.

(Note that IPA was also used as "solder/flux thinner", and inventoried separately from 1978-1989; 100+ gal/yr or less); Methanol: 200 gal/yr, 1971-1984; <30 gal/yr, 1985-1989; TCE: 400 gal/yr, 1971-1977. PCE: 200 gal/yr, 1978-1979; TCA: 400 gal/yr, 1980-1989; Freon 113: 200 gal/yr, 1978-1979; >400 gal/yr, 1980-1989.

¹²⁸ BNSF, 129 S. Ct. 1870, 1881 (2009).

¹²⁹ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Figures 9, 10, 12

The geographic divisibility of the redistribution of PCB contaminated soil as part of site redevelopment activities, based on the analysis of geographic extent of Granger's soil movement and the limited subsequent geographic extent of any HP/Agilent soil movement as described in the Expert Report of Brian Magee,¹³⁰ indicates Granger was the site operator who was primarily responsible for the movement of soil that is reasonably expected have been contaminated with PCBs from Granger's site operations. While there is some uncertainty in the soil movement reconstruction and how some of the soil with PCB contamination was moved to its current location, based on this geographic divisibility, 80-90% of the redistribution of PCB contaminated soil is apportioned to Granger and 10%-20% is apportioned to HP/Agilent.

TCE Site Impact Apportionment

TCE site impacts are the result of the direct release of TCE to site soils. Redistribution of TCE contaminated soil as part of site redevelopment activities did not result in any identified spread of TCE contamination which required cleanup. Therefore, the 10%-30% of the overall TCE harm results from direct TCE contamination.

There are only two areas that were identified as requiring remediation, the area in the vicinity of the sump/piping system and the original chemical storage area. Based on the figures in the PEA titled "Maximum Detected TCE Concentrations In Soil Vapor Samples Within Proposed Future Development" and "Soil Vapor Sample Locations With Estimated Risk Exceeding 1×10^{-6} ,"¹³¹ the geographic extent and magnitude of TCE contamination is greater in the sump/piping system area compared to original chemical storage area. Thus, the direct TCE contamination can be split 70-90% in the sump/piping system and 10%-30%% in the original chemical storage area.

Granger was the only user of the sump/piping system, therefore Granger is apportioned all of the direct TCE contamination in that area. Both Granger and HP used the original chemical storage area, but there is some uncertainty regarding whether the contamination in the original chemical storage area is an extension of contamination from the sump/piping system¹³² or a result of releases in the storage area. If there was releases in the storage area, there is also some uncertainty what the relative contribution is among Granger and HP – since based on the lack of other VOC used by HP it is expected than any HP contribution would be minor. Assuming a scenario where there is an HP/Agilent contribution to the TCE contamination in the original chemical storage area, 50-80% of the TCE contaminated soil is apportioned to Granger and 20%-50% is apportioned to HP/Agilent.

¹³⁰ Expert Report of Brian Magee. December 9, 2019. The Board of Trustees of the Leland Stanford Junior University vs. Agilent Technologies, Inc., and HP Inc. Case No. 3:18-CV-01199 VC.

¹³¹ Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017. Figures 9 & 12.

¹³² Haley & Aldrich, Inc. Report on Preliminary Endangerment Assessment. 1601 S. California Avenue. Palo Alto, California. October 2017.

Apportionment Calculations

The range of apportionment factors described above were combined to calculate various apportionment scenarios between Granger and HP/Agilent for the range of plausible contribution scenarios described above.

	<u>Granger</u>	<u>HP/Agilent</u>
MAX	97.8%	11.0%
MIN	89.0%	2.2%
AVERAGE	94.1%	5.9%

70% PCB/30% TCE – 70% TCE from Sump/Piping

Overall Impact	50%	20%	21%	9%
PRPs	Operator Direct Contribution of PCBs	Operator Redistribution of PCBs	Operator Direct Contribution of TCE to Sump/Piping	Operator Direct Contribution of TCE to Original Chemical Storage Area
Granger	100%	90%	100%	80%
HP/Agilent	0%	10%	0%	20%
	<u>Granger</u>	<u>HP/Agilent</u>		
Direction Contribution of PCBs	50.0%	0.0%		
Direct Contribution of TCE	28.2%	1.8%		
Redistribution of PCBs	18.0%	2.0%		
TOTAL	96.20%	3.80%	100.0%	
Overall Impact	50%	20%	21%	9%
PRPs	Operator Direct Contribution of PCBs	Operator Redistribution of PCBs	Operator Direct Contribution of TCE to Sump/Piping	Operator Direct Contribution of TCE to Original Chemical Storage Area
Granger	95%	80%	100%	50%
HP/Agilent	5%	20%	0%	50%
	<u>Granger</u>	<u>HP/Agilent</u>		
Direction Contribution of PCBs	47.5%	2.5%		
Direct Contribution of TCE	25.5%	4.5%		
Redistribution of PCBs	16.0%	4.0%		
TOTAL	89.00%	11.00%	100.0%	

90% PCB/10% TCE – 70% TCE from Sump/Piping

Overall Impact	70%	20%	7%	3%
PRPs	Operator Direct Contribution of PCBs	Operator Redistribution of PCBs	Operator Direct Contribution of TCE to Sump/Piping	Operator Direct Contribution of TCE to Original Chemical Storage Area
Granger	100%	90%	100%	80%
HP/Agilent	0%	10%	0%	20%
	<u>Granger</u>	<u>HP/Agilent</u>		
Direction Contribution of PCBs	70.0%	0.0%		
Direct Contribution of TCE	9.4%	0.6%		
Redistribution of PCBs	18.0%	2.0%		
TOTAL	97.40%	2.60%	100.0%	
Overall Impact	70%	20%	7%	3%
PRPs	Operator Direct Contribution of PCBs	Operator Redistribution of PCBs	Operator Direct Contribution of TCE to Sump/Piping	Operator Direct Contribution of TCE to Original Chemical Storage Area
Granger	95%	80%	100%	50%
HP/Agilent	5%	20%	0%	50%
	<u>Granger</u>	<u>HP/Agilent</u>		
Direction Contribution of PCBs	66.5%	3.5%		
Direct Contribution of TCE	8.5%	1.5%		
Redistribution of PCBs	16.0%	4.0%		
TOTAL	91.00%	9.00%	100.0%	

70% PCB/30% TCE – 90% TCE from Sump/Piping

Overall Impact	50%	20%	27%	3%
PRPs	Operator Direct Contribution of PCBs	Operator Redistribution of PCBs	Operator Direct Contribution of TCE to Sump/Piping	Operator Direct Contribution of TCE to Original Chemical Storage Area
Granger	100%	90%	100%	80%
HP/Agilent	0%	10%	0%	20%
	<u>Granger</u>	<u>HP/Agilent</u>		
Direction Contribution of PCBs	50.0%	0.0%		
Direct Contribution of TCE	29.4%	0.6%		
Redistribution of PCBs	18.0%	2.0%		
TOTAL	97.4%	2.6%	100.0%	
Overall Impact	50%	20%	27%	3%
PRPs	Operator Direct Contribution of PCBs	Operator Redistribution of PCBs	Operator Direct Contribution of TCE to Sump/Piping	Operator Direct Contribution of TCE to Original Chemical Storage Area
Granger	95%	80%	100%	50%
HP/Agilent	5%	20%	0%	50%
	<u>Granger</u>	<u>HP/Agilent</u>		
Direction Contribution of PCBs	47.5%	2.5%		
Direct Contribution of TCE	28.5%	1.5%		
Redistribution of PCBs	16.0%	4.0%		
TOTAL	92.0%	8.0%	100.0%	

90% PCB/10% TCE – 90% TCE from Sump/Piping

Overall Impact	70%	20%	9%	1%
PRPs	Operator Direct Contribution of PCBs	Operator Redistribution of PCBs	Operator Direct Contribution of TCE to Sump/Piping	Operator Direct Contribution of TCE to Original Chemical Storage Area
Granger	100%	90%	100%	80%
HP/Agilent	0%	10%	0%	20%
	<u>Granger</u>	<u>HP/Agilent</u>		
Direction Contribution of PCBs	70.0%	0.0%		
Direct Contribution of TCE	9.8%	0.2%		
Redistribution of PCBs	18.0%	2.0%		
TOTAL	97.8%	2.2%	100.0%	
Overall Impact	70%	20%	9%	1%
PRPs	Operator Direct Contribution of PCBs	Operator Redistribution of PCBs	Operator Direct Contribution of TCE to Sump/Piping	Operator Direct Contribution of TCE to Original Chemical Storage Area
Granger	95%	80%	100%	50%
HP/Agilent	5%	20%	0%	50%
	<u>Granger</u>	<u>HP/Agilent</u>		
Direction Contribution of PCBs	66.5%	3.5%		
Direct Contribution of TCE	9.5%	0.5%		
Redistribution of PCBs	16.0%	4.0%		
TOTAL	92.0%	8.0%	100.0%	

Adam H. Love, Ph.D.

Vice President/Principal Scientist, Litigation Practice Leader

TECHNICAL SPECIALTIES

Dr. Love leads Roux's Litigation Practice Group and provides forensic litigation support and expert witness services to clients throughout the United States on environmental litigation, environmental insurance coverage, and toxic tort related matters. Dr. Love's experience includes strategic and technical analysis and guidance regarding numerous complex groundwater, soil, sediment, soil vapor and air contaminated sites. He has also provided expert technical guidance for state legislative actions and federal advisory panels on a range of traditional and non-traditional environmental hazards. Dr. Love's expertise has been developed through a unique variety of University, Federal and post-academia work, including developing leading-edge methods for addressing forensic questions related to weapons of mass destruction for the Federal Government.

Dr. Love's areas of expertise include:

- Environmental forensics (identifying sources and timing of chemical releases);
- Chemical/isotopic fingerprinting;
- Contaminant transport/fate in sediments, soils, water, groundwater, and air;
- Divisibility and apportionment of contamination among PRPs;
- Human (i.e. Toxic tort claims and Prop 65) and ecological exposure assessment;
- Assessments of petroleum (crude oil, diesel, and gasoline), chlorinated and other solvents (PCE, TCE, TCA, 1,4-dioxane), pesticides, PCBs, PAHs, radionuclides, explosives and heavy metals;
- Environmental site characterization and remediation; and,
- Environmental data analysis.

Dr. Love's capabilities include the use of advanced models and analytic methods to understand and interpret contaminant characterization, transport, and fate for a range of applications. By employing multiple lines of scientific evidence through analyses that couple field measurements, fate and transport calculations, and historical operations/documents, he provides internally consistent opinions and results. Dr. Love is experienced at creating and evaluating Site Conceptual Models based on an understanding of environmental and engineered systems that involve a wide range of matrices (i.e. soils, sorbents, air, natural waters, constructed materials, and biological tissue).

CREDENTIALS

Post Doctorate, Forensic Science Center, Lawrence Livermore National Laboratory, 2004;
 Ph.D., Environmental Engineering, University of California at Berkeley, Berkeley, CA, 2002;
 M.S., Material Science and Mineral Engineering - Hydrogeology, University of California at Berkeley, Berkeley, CA, 1998; and,
 B.A., Geoscience, Franklin & Marshall College, Lancaster, PA, 1996.

EXPERIENCE SUMMARY

20+ years of experience in environmental science/engineering, use of forensic signatures to determine source and timing of contamination, and contaminant assessment, transport and remediation.

- Roux Associates, Inc., Vice President, Litigation Practice Group Leader 2016-Present; Principal Scientist, 2013-Present.
- Johnson Wright Inc., Principal Scientist, Environmental Forensics Practice Leader 2009-2013.
- Lawrence Livermore National Laboratory, Principal Investigator/Scientist, Forensic Science Center, 2002-2009.
- California Department of Health Services – Drinking Water Program/Technical Programs Branch, Standards and Technology Unit Staff, 2000-2002.
- University of California, Berkeley, Graduate Student Researcher/Instructor, 1996-2002.
- Franklin & Marshall College, Undergraduate Researcher/Laboratory Teaching Assistant, 1994-1996.

EXAMPLE PROJECTS

Sediment Contamination Reconstruction

Fox River Superfund Site, WI – Expert Witness. Prepared an Expert Report evaluating the technical bases for a range of methodologies used to allocate contribution of polychlorinated biphenyls (PCB) to contaminated sediments. Performed fate and transport analyses as the basis for allocation to estimate mass contributions from various PRPs.

Kalamazoo River Superfund Site, MI – Evaluated the annual total suspended solid (TSS) discharges from 14 facilities to the Kalamazoo River sediments over the 25+ year relevant period of applicable discharges. Allocated TSS discharges to generator facility when secondary facility was used for wastewater treatment. Evaluated changes in facility TSS treatment efficiency and relative TSS contributions throughout the relevant period.

Passaic River (Diamond Alkali) Superfund Site, NJ – Expert Witness. Evaluated available historical data, performed fate and transport analyses, and developed a detailed understanding of facility operations to support the facility designation of *de minimis* status.

Gowanus Canal Superfund Site, NY – Expert Witness. Evaluated available historical data, performed fate and transport analyses, and developed a detailed understanding of facility operations to support the facility designation of *de minimis* status.

San Diego Harbor, CA – Expert Witness. Evaluated available historical data, performed fate and transport analyses, and developed a detailed understanding of facility operations to support an Expert Report that evaluated potential metals, PCBs, and petroleum releases from the Silvergate Power Plant.

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San Francisco Bay, CA – Collected sediment cores from Naval Air Station Alameda and performed isotopic and chemical analyses that enabled reconstruction of historical sediment contamination.

Industrial

Manufacturing Facilities, CA – Provided litigation support based on fate and transport analysis related to timing of groundwater contamination resulting from multiple potential PCE, TCE, TCA and 1,4-dioxane releases to groundwater managed by Orange County Water District. Additional chemical fingerprinting analysis was performed to distinguish on-site versus off-site contributions of chlorinated solvents and their degradation products to the associated groundwater plumes.

Industrial Facility, AZ – *Expert Witness*. Provided litigation support based on fate and transport analysis related to source and timing of groundwater contamination resulting from potential PCE, TCE, and TCA sources.

Former Military Facility, CA. – *Expert Witness*. Evaluated claimed cleanup actions and costs related to site investigation and remediation of a former military site.

Former Military Facility, KS. – *Expert Witness*. Evaluated claimed cleanup actions and costs related to site investigation and remediation of a former military site.

Aerospace Facility, CA. – *Expert Witness*. Evaluated available historical data, performed fate and transport analyses, and developed a detailed understanding of facility operations that provide the technical basis for assessing contribution of PCE, TCE, and TCA from various operations.

Transportation Spill, CA. – *Expert Witness*. Prepared an Expert Report evaluating the potential ecological impact of an ink spill into a local river.

Former Military Facility, CA. – Performed site investigation of soil and groundwater at a former military site to determine the extent and magnitude of historical solvents and petroleum releases in order to inform remedial strategy. Obtained regulatory closure under low-threat closure criteria.

Drycleaners

Pleasanton, CA – Evaluated site conditions and advised on investigation and remediation strategy. Developed conceptual site model. Developed strategy for regulatory interactions.

Santa Barbara, CA – *Expert Witness*. Prepared an Expert Report assessing sources of PCE contamination to soil and groundwater contamination, including drycleaner discharges into sewer system and releases at adjacent sites. Rebuttal Expert Report also assessed the expected remedial costs for PCE contamination at and emanating from the site.

San Jose, CA – *Expert Witness*. Prepared an Expert Declaration regarding the potential sources of PCE contamination to soil and groundwater contamination and the divisibility of the contamination from the potential sources.

Napa, CA – *Expert Witness*. Prepared an Expert Declaration regarding the potential sources of PCE contamination to soil and groundwater contamination.

Davis, CA – *Expert Witness*. Prepared an Expert Report regarding the potential sources of PCE contamination of groundwater.

Numerous Sites, USA – Evaluation of the source, timing, and/or contribution from multiple PRPs to comingled PCE plumes from drycleaner sites related to environmental insurance claims.

Per- and Polyfluorinated Alkyl Substances (PFAS)

AFFF PFAS Forensics – Evaluated spectrum of AFFF formulations to identify unique forensic signatures of source and timing of AFFF releases and relative contributions.

Groundwater Plumes, NY – Sampled and evaluated impacts at multiple industrial sites to determine the source(s), extent and magnitude of PFAS concentrations in groundwater.

Wastewater Effluent, NJ – Evaluated PFAS chemicals in wastewater effluent in order to assess sources and relative contributions of PFAS discharges.

Military Base Soil/Groundwater Impacts, CA – Evaluated extent and magnitude of PFAS impacts for in AFFF training area and remedies that are protective of human and ecological exposure endpoints.

Heavy Metals

Battery Recycling Facility, CA – *Expert Witness*. Evaluated available historical emissions/capacity data, performed fate and transport analyses, and assessed the extent and magnitude of lead and other heavy metals contamination in soils surrounding the Exide Technologies lead battery recycling facility. Worked together with lead regulatory agency to develop interior/exterior assessment and remediation protocols. Analyzed reported results of community blood lead data.

Steel Manufacturing Facility, CA – *Expert Witness*. Evaluated available historical operations, soil lead and arsenic data, and chemical signatures of steel manufacturing from soils within and adjacent to the historic steel manufacturing facility.

Facility and Regulatory Assessments of Hexavalent Chromium, CA – Evaluated how changes in regulatory rules and enforcement would impact facilities in Los Angeles County. Created inventory of facilities in LA County that emitted hexavalent chromium. Evaluated alternative technology to using hexavalent chromium for metal plating.

GIS Database of Potential Hexavalent Chromium Sources, CA – Using knowledge of industrial processes combined with industrial compliance and reporting documentation, developed a GIS database of potential hexavalent sources for a Southern California county.

Naturally-Occurring Hexavalent Chromium in Drinking Water, CA – *Expert Witness*. Assessed potential industrial sources

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and naturally-occurring sources of hexavalent chromium to a municipal drinking water distribution system.

Hexavalent Chromium Air Emissions from a Metal Plating Facility, CA – Expert Witness. Modeled hexavalent chromium emissions from multiple sources of hexavalent chromium in an industrial area, including a metal-plating facility. Model was calibrated and validated using actual air sampling data. Determined the extent and magnitude of emissions target facility and the relative contribution compared to other nearby sources.

Metal Recycling Facility, CA – Assessed facility compliance with DTSC hazardous waste regulations. Negotiated with DTSC on behalf of client. Developed plan for hazardous waste treatment/disposal that meets DTSC requirements.

Mixed Industrial Region, IN – Evaluated historical operations, soil lead and arsenic data, and chemical signatures of potential industrial sources with locations on and adjacent to the historic industrial manufacturing facilities.

Metal Plating Facility, IN – Expert Witness. Prepared an Expert Report regarding the evaluation of a claimed environmental release and associated costs that occurred during an electrical fire at a metal plating facility.

Metal Plating Facility, CA – Expert Witness. Prepared an Expert Declaration regarding the evaluation of the various former site operations that potentially contributed site contamination.

Mineral Processing Facility, CA – Expert Witness. Prepared an Expert Report regarding the contribution of an accidental elemental mercury spill at the Searles Valley Minerals Operations Inc. site to the overall historic site contamination. Analyzed invoices and categorized cleanup costs into emergency spill costs vs. soil remediation activities.

Petroleum

Petroleum Transfer Facility, CA – Expert Witness. Prepared an Expert Report assessing the release of gasoline, diesel fuel, and crude oil over 50+ years into the soil and sediment of Avila Beach, CA. Identified the source and timing of the historical contamination and the nature of the releases using multiple lines of scientific forensic techniques. Performed fate, transport and degradation analysis of gasoline, diesel fuel, and crude oil to determine the divisibility of “sudden and accidental” releases from frequent releases related to facility operations.

Pipeline Release, CA – Expert Witness. Performed technical evaluation of historical operations, extent and magnitude of impacts, and fate and transport pathways to develop model for an allocation of contribution among multiple pipeline companies, sewer operator, and oil recycling facility.

Pipeline Release, OK – Expert Witness. Performed technical evaluation of extent and magnitude of impacts, fate and transport pathways, and bioremediation potential.

Documented site cleanup activities were consistent with State of Oklahoma’s process for regulatory closure..

Retail Gasoline Stations, CO – Expert Witness. Performed fate, transport and degradation analysis of gasoline to determine the timing of gasoline releases. Prepared an Expert Report regarding the release of gasoline from 80+ fueling facilities throughout the state.

Crude Oil Refinery, CA – Expert Witness. Performed evaluation of timing of release and source of contamination related to historical refinery operations.

Used Oil System Collection and Recycling, CA – Expert Witness. Developed a report for the State of California on how to improve the state’s used oil recycling program. Provided testimony to CA State legislature on proposed used oil recycling incentive bills. Key technical contributor to stakeholder discussion on ongoing CalRecycle efforts for additional used oil recycling improvement.

Retail Gasoline Station, MD – Expert Witness. Performed evaluation of timing of release and source of contamination impacting nearby groundwater. Evaluated contaminant contributions from adjacent property and both current and former owner/operator.

Underground Fuel Oil Tank, NY – Expert Witness. Performed evaluation of timing of release and source of contamination for fuel oil impacting groundwater.

Long Island Sound, NY – Expert Witness. Evaluated if the released liquid was an oil, as per Oil Pollution Act of 1990 (OPA 90).

Timing of Petroleum Release, Numerous States – Performed fate, transport and degradation analysis of gasoline and fuel oil to determine the timing of releases at 200+ gasoline station and fuel oil sites related to environmental insurance claims.

Landfills

Groundwater solvent plume, CA – Expert Witness. Evaluated the available operation information, site investigation data, and performed fate and transport analysis to determine the source, timing, and number of release events at landfill operating for over 50 years.

Multi-COC Contamination, NJ – Evaluated the available operation information, site investigation data, and performed fate and transport analysis to determine the divisibility of the COC contamination among PRPs.

Multi-COC Contamination, WA – Evaluated the available operation information, site investigation data, and performed fate and transport analysis to determine the divisibility of the COC contamination among PRPs.

Radionuclides

Radionuclide-containing Products Manufacturing, PA – Expert Witness. Evaluated available historical data, performed fate and transport analyses, and developed a detailed understanding of facility operations at the Safety Light Superfund Site that provided the technical basis for recommendations to DOJ on a feasible strategy for and

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potential allocation of arranger liability. Site contaminated with numerous radionuclides (tritium [H-3], strontium [Sr-90], cesium [Cs-137], and radium [Ra-226]).

Release of Radionuclides from Testing Equipment, OK – Evaluated whether the response actions taken were reasonable and necessary related to the investigation and remediation of a cesium [Cs-137] release.

Radionuclide Labeling Facility, CA – Sampled tree rings in the vicinity of a Lawrence Berkeley National Laboratory stack that emitted tritium [H-3] and analyzed tree rings in order to reconstruct facility emission for >50 years.

Pesticides

Atrazine, Numerous locations in USA – Provided expert litigation support regarding the fate and transport of atrazine, timing of release, and potential impacts to drinking water sources.

Glyphosate, Oakland, CA – Provided deposition and trial testimony regarding the source of glyphosate contamination causing property damage on an adjacent parcel of land based on atmospheric transport, technology dispersal capability, site conditions, and impact patterns on parcel.

Trichloropropane (1,2,3-TCP), CA – Evaluated potential sources of trichloropropane groundwater contamination in drinking water wells.

Human Exposure Assessment

Chemical Vapor Exposure, WA – *Expert Witness.* Evaluated the source of chemical vapors and the potential for downwind vapor exposure to workers.

School District Astro turf, CA – Collected astro turf samples and conducted consumer product testing to provide data which supported the assessment of potential exposure pathways and human health risk assessment for children, workers, and recreational users.

Caustic Liquid Exposure, MI – Evaluated potential sources of caustic chemical liquids that resulted in worker skin burns.

Proposition 65 Phthalates, CA – Collected consumer product samples and conducted consumer product testing to determine potential consumer exposure pathways and magnitude.

Proposition 65 Heavy Metals, CA – Evaluated lead data and developed a testing and evaluation plan to determine levels of naturally occurring metals in identified food products.

Explosive and Fire Assessment

Forensic Explosive Evaluation, CA – *Expert Witness.* Collected field samples and evaluated chemical and operational information to determine the likely cause of an explosion event at an industrial facility.

Forensic Deflagration Evaluation, CA – *Expert Witness.* Evaluated field reports, inventory, and operational information to determine the likely contributing causes of

a deflagration event that occurred in a transportation vehicle.

ADDITIONAL AREAS OF EXPERTISE AND EXPERIENCE Weapons of Mass Destruction Preparation and Response

Provide technical guidance and operational plan reviews for responding to WMD events. Technical guidance includes emergency response, site characterization, WMD forensics, site remediation, fate and transport, site closure. Co-led team in development of DHS/EPA Federal facility restoration guidance document for critical infrastructure.

Development of Chemical/Isotopic Signatures/ Fingerprints

Develop and validate new chemical/isotopic fingerprint strategies as well as utilize peer-reviewed techniques. Experienced with numerous approaches: intended chemical markers and additives, chemical component ratios, degradation analysis, isotope analysis, biomarkers, isomers/congener analysis.

Chemical Fate and Transport Modeling

Conducts analyses using a variety of industry-accepted approaches, including analytic solutions and numerical models MODFLOW, MT3D, HYDRUS, BIOCHLOR, CAMEO/ALOHA, CALPUFF, HPAC. Determines aqueous and/or atmospheric plume migration exposure duration and magnitude.

JOURNAL PUBLICATIONS

Environmental Forensics

Ram, N.M.; Schneider, M.W.; Gerbig, C.A.; Nevins, N.; Love, A.H. (2019) Allocating Cleanup Costs Among Potentially Responsible Parties. *Remediation*. 30:33-45.

Zdon, A.; Rainville, K.; Buckmaster, N.; Parmenter, S.; Love, A.H. (2019) Identification of Source Water Mixing in the Fish Slough Spring Complex, Mono County, California, USA. *Hydrology*. 6, 26.

Love, A.H. and Zdon, A. (2018) Use of Radiocarbon Ages to Narrow Groundwater Recharge Estimates in the Southeastern Mojave Desert, USA. *Hydrology*. 5(3):51.

Zdon, A.; Davisson, M.L.; Love, A.H. (2018) Understanding the source of water for selected springs within Mojave Trails National Monument, California. *Environmental Forensics*. 19(2), 99-111.

Dorrance, L.R.; Kellogg, S.; Love, A.H. (2017) What You Should Know About Per- and Polyfluoroalkyl Substances (PFAS) for Environmental Claims. *Environmental Claims Journal*, 29:4, 290-304.

Shelley, T.M.; Love, A.H. (2015) A Question of Proof: Using Isotope Analysis and Chemical Fingerprinting to Identify the Source of Contamination. *Environmental Claims Journal*, 27:3, 264-275.

Zdon, A.; Davisson, M.L.; Love, A.H. (2015) Testing the Established Hydrogeologic Model of Source Water to the Amargosa River Basin, Inyo and San Bernardino Counties, California. *Environmental Forensics*. 16(4).

Love, A.H., J.R. Hunt, J.P. Knezovich. (2004) Improving Tritium Exposure Reconstructions Using Accelerator

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Mass Spectrometry. *Analytical and Bioanalytical Chemistry*. 379(2): 198-203.

Love, A.H., B.K. Esser, J.R. Hunt. (2003) Reconstructing Contaminant Deposition in a San Francisco Bay Marina. *Journal of Environmental Engineering*. 129 (7):659.

Love, A.H., J.R. Hunt, J.P. Knezovich. (2003) Use of Carbon-14 and Tritium in Tree Rings to Reconstruct Tritium Exposure at Lawrence Berkeley National Laboratory. *Environmental Science and Technology*. 37 (19): 4330.

Contaminant Fate and Transport

Kuo, I-Feng; Grant, C.; Gee, R.; Chinn, S.; Love, A.H. (2012) Determination of the Surface Effects on Sarin Degradation *The Journal of Physical Chemistry C*. 116 (17), 9631-9635.

Love, A.H. (2008) Determining Important Parameters Related to Cyanobacterial Alkaloid Toxin Exposure. *Advances in Experimental Medicine and Biology*. Hudnell, H. Kenneth (Ed.). 619:453-464.

Loui, A., Ratto, T.V., Wilson, T.S., McCall, S.K., Mukerjee, E.V., Love, A.H., Hart, B.R. (2008) Chemical vapor piezoresistive microcantilevers. *The Analyst*. 133(5): 608 – 615.

Love, A.H., M.L. Hanna, P.R. Coronado, J.G. Reynolds (2005) Engineering surface functions groups on silica aerogel for enhanced cleanup of organics from produced water. *Separation Science*. 40:311-320.

Love, A.H., Vance, A.L., Reynolds, J.G., Davisson, M.L. (2004) Investigating the affinities and persistence of VX nerve agent in environmental matrices. *Chemosphere*. 57: 1257-1264.

Weapons of Mass Destruction Preparation and Response

Campell, C.G.; Kirvel, R.D.; Love, A.H.; Raber, E. (2012) Decontamination After a Release of B. anthracis Spores. *Biosecurity and bioterrorism: biodefense strategy, practice, and science* 10(1):108-22.

Love, A.H.; Bailey, C.G.; Hanna, M.L.; Hok, S; Vu, A.K.; Reutter, D.J.; Raber, E. (2011) Efficacy of Liquid and Foam Decontamination Techniques for Chemical Warfare Agents on Indoor Surfaces. *J. Hazardous Materials*. 196; 115-122.

Watson, A; Hall, L; Raber, E; Hauschild, V.D.; Dolislagerd, F; Love, A.H.; Hanna, M.L. (2011) Developing Health-Based Pre-Planning Clearance Goals for Airport Remediation Following Chemical Terrorist Attack: Introduction and Key Assessment Considerations. *Human and Ecological Risk Assessment: An International Journal*, 17(1): 2 – 56.

Watson, A; Dolislagerd, F; Raber, E; Hall, L; Hauschild, V.D.; Love, A.H. (2011) Developing Health-Based Pre-Planning Clearance Goals for Airport Remediation Following a Chemical Terrorist Attack: Decision Criteria for Multipathway Exposure Routes.

Human and Ecological Risk Assessment: An International Journal, 17(1) : 57 – 121.

Campbell C.J., Love A.H. (2008) Monitoring Water Resources for Threats to Water Security. *New Topics in Water Resources Research and Management*. Henrik M. Andreassen (Ed.). Nova Science Publishers, Inc. pp. 195-235.

Ramkumar, S.; Love, A.H.; Sata, U.R.; Kendall, R.J. (2008) Next-Generation Nonparticulate Dry Nonwoven Pad for Chemical Warfare Agent Decontamination. *Ind. Eng. Chem. Res.* 47: 9889-9895.

Other Publications

Boston, C; Love, A.H. (2018) Understanding the Uncertainty with Unregulated Contaminants. American Bar Association. Environmental & Energy Litigation Committee Newsletter. Spring 2018. 2(3):9-16.

Baumann, J.; Oliver, D.H.; Dorrance, L.R; Love, A.H. (2018): Approaches to Reduce Conflict when Insuring the Environmental Cleanup of Closed Military Bases Intended for Redevelopment, *Environmental Claims Journal*

M.R. Johnson, J.G. Reynolds, Love, A.H. (2008) Improving Used Oil Recycling in California. *Contractor Report to the California Integrated Waste Management Board*. California Environmental Protection Agency. May 2008. Publication #610-08-008.

Vogel, J.; Love, A.H. (2005) Quantitating Isotopic Molecular Labels with Accelerator Mass Spectrometry. *Methods in Enzymology* 402:402-22.

Chiarappa-Zucca, M.L.; Dingley, K.H.; Roberts, M.L.; Love, A.H. (2002) Sample Preparation for Quantitation of Tritium by Accelerator Mass Spectrometry. *Analytical Chemistry* 74(24):6285-90.

Roberts, M.L.; Hamm, R.W.; Dingley, K.H.; Love, A.H. (2000) A compact tritium AMS system. *Nuclear Instruments and Methods in Physics Research Section B Beam Interactions with Materials and Atoms* 172(1-4):262-267.

SELECTED CONFERENCE PRESENTATIONS

Environmental Forensics

Dorrance, L.; Love, A.H.; (2018) Rewind the Clock: Use of Environmental Forensics to Investigate Timing of Release. AEHS 29th Annual International Conference on Soil, Water, Energy, and Air, Forensics Section. March 2019.

Dorrance, L.; Love, A.H.; (2018) Outlook of Environmental Forensics in Distinguishing Sources of Perfluoroalkyl and Polyfluoroalkyl Substances. Emerging Contaminants Summit 2018. March 2018

Dorrance, L.; Love, A.H.; (2018) Metals Forensics at Ghost Factories. AEHS 28th Annual International Conference on Soil, Water, Energy, and Air, Forensics Section. March 2018

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Love, A.H.; Dorrance, L. (2017) Current Limitations and Outlook of Environmental Forensics for PFOS, PFOA and Related Perfluoroalkyl and Polyfluoroalkyl Substances. AEHS 27th Annual International Conference on Soil, Water, Energy, and Air, Forensics Section. March 2017.

Love, A.H.; Dorrance, L. (2016) Lessons in Applying Forensic Techniques to Sediment Sites Throughout the US. AEHS 26th Annual International Conference on Soil, Water, Energy, and Air, Forensics Section. March 2016.

Love, A.H.; Zdon, A. (2015) Assessing Limited Water Resources Forensics. AEHS 25th Annual International Conference on Soil, Water, Energy, and Air, Forensics Section. March 2015.

Love, A.H., Brown, C. (2014) Robust Data Analysis for Utilizing Chemical Data for Forensic Applications. AEHS 24th Annual International Conference on Soil, Water, Energy, and Air, Forensics Section. March 2014.

Love, A.H. (2014) Incorporating Environmental Lines of Evidence into Nuclear & Criminal Forensics. Conference on Application of Accelerators in Research and Industry (CAARI). May 2014

Shelley, T.M., Love, A.H. (2014) Prove it! – Using Isotope Analysis to Prove Contamination Source. FETTI Conference. October 2014.

Love, A.H. (2013) Using 1,4 Dioxane as a Forensic Tool at Solvent Sites. AEHS 23th Annual International Conference on Soil, Water, Energy, and Air, Forensics Section. March 2013.

Love, A.H. (2013) Testing the Established Regional Hydrologic Conceptual Model in the Amargosa River Basin, California and Nevada. National and International Conference on Groundwater. April 2013.

Contaminant Fate and Transport

Cunningham, A.B.; Hogan, J.P.; Love, A.H.; Munk, I.M. (2019) PFAS Environmental Risks - What are People Actually Doing? Environmental Risk & Litigation Conference. June 18, 2019.

Love, A.H.; Newman, R.G.; Kinslow, C.J.; Vaughn, K. (2018) PFAS: Evolution from Emerging Contaminant to Frequent Headliner. Environmental Risk & Litigation Conference. June 12, 2018.

Love, A.H.; Smith, S.E.; Slaughter, J.B.; Connor, P.; Scarcella, M. (2017) Defending Lead Cases: Strategies and Tactics for a Trending Toxic Tort. DRI Webinar. October 28, 2017.

Love, A.H.; Hunter, C.; London, M.A.; Swetman, M. (2017) Perfluorinated Chemicals - The Science and Law Behind PFOA. Environmental Risk & Litigation Conference. June 20, 2017.

Love, A.H.; Smith, S.E.; Connor, P.; Scarcella, M.; Kelso, P. Get the Lead out! Proactive Risk Measures in

Response to America's Environmental Crisis. 2017 EECMA Conference. April 2017.

Edlin, N.; Love, A.H. (2016) Did Law Kill Science? Understanding the Impact of Davis v. Honeywell and the "One Fiber Theory" on Asbestos and Environmental Cases. FETTI Conference. September 2016.

Love, A.H., (2010) Understanding Agent Fate Systems: Is the perfect the enemy of the good? The 2010 Chemical and Biological Defense Science and Technology Conference. Orlando, Florida. 15-19 November 2010.

Love, A.H., Koester, C.J., Alcaraz, A., Hanna, M.L., Ho, P., Reynolds, J.G., Raber, E. (2007) "Determining CWA Environmental Fate to Optimize Remediation for Indoor Facilities." 2007 EPA Decontamination Workshop. Durham, North Carolina, June 20-22, 2007.

Love, A.H., Koester, C.J., Alcaraz, A., Hanna, M.L., Ho, P., Reynolds, J.G., Raber, E. (2007) "Determining CWA Environmental Fate to Optimize Remediation for Indoor Facilities." 6th DHS Conference on Chemical and Biological Technologies: Food Protection, Restoration, and Architecture Studies. Madison Wisconsin, June 5-8, 2007.

Love, A.H. (2006) "Radiologic Dispersal Devices: Enhancing Response Capability" LLNL Educational Outreach to DTRA CB Defense. August 31, 2006. Fort Belvoir, Virginia.

Love, A.H. (2005) Determining Important Parameters Related to Cyanobacterial Alkaloid Toxin Exposure. International Symposium on Cyanobacterial Harmful Algal Blooms (ISOC-HAB). U.S. Environmental Protection Agency. Durham, North Carolina. Sept 6-8, 2005.

Love, A.H., Davisson, M.L., Vance, A.L., Reynolds, J.G. (2005) Understanding the Interaction of Chemical Agents with Environmental Matrices at Low Levels. Working Together: R&D Partnerships in Homeland Security. April 2005. Boston, Massachusetts.

Weapons of Mass Destruction Preparation and Response

Love, A.H., Hanna, M.L., Hok, S., Smith, W.J., Vu, A.K., Reutter, D., Raber, E. (2010) Evaluating Strategies for CWA Decontamination of Indoor Facilities. 2010 US EPA Decontamination Research and Development Conference. Research Triangle Park, North Carolina. April 13-15, 2010.

Glascoc, L., Alai, M., Love, A.H., Johnson, M., Einfeld, W. (2005) A Technology Acquisition Strategy for the Security of Water Distribution Networks. AWWA Water Security Congress. Oklahoma City, OK. April 2005.

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Site Investigation and Remediation

Love, A.H.; Sullivan, C.N.; Alviggi, C. (2018) What, me worry? Environmental Reopeners. DRI Toxic Tort and Environmental Seminar. March 2018.

Nuti, P., Love, A.H. (2010) Navigating the Complexities of Sediment Site Cleanup. 2010 EECMA Conference. May 2010.

Love, A.H.; Stevens, M.A.; Silver, L. (2012) The Anatomy of an Environmental Standard. 2012 EECMA Conference. May 2012.

Wozniak, A.A., Love, A.H. (2011) Optimizing Environmental Costs: Are Insureds Paying Too Much?. 2011 EECMA Conference. May 2011.

Other Presentations

Love, A.H.; Brenneman, L.M.; Renfro, T.J. (2019) Climate Change Vulnerability Assessment and Adaptation at Environmental Sites DRI Toxic Tort and Environmental Seminar. March 2019.

Love, A.H.; Singarella, P.; Tai, S.; Wiseman, H. (2018) Science on Trial: Is It Legally Honest?. American Bar Association Section of Environmental, Energy, and Resources. 47th Spring Conference. April 20, 2018.

PROFESSIONAL AFFILIATIONS AND ACTIVITIES

- Editorial Board - Journal of Environmental Forensics
- ABA Section of Litigation – Expert Witness Committee
- International Society of Environmental Forensics
- American Chemical Society (ACS), Member #2301067
- Forensic Expert Witness Association
- Bar Association of San Francisco
- DRI
- Organization for the Prohibition of Chemical Weapons (2013 Nobel Peace Prize Recipient), US Analysis Team at Lawrence Livermore National Laboratory, 2004-2009.

PATENTS

Systems and methods for generation of hydrogen peroxide vapor. United States Patent 08899556
 Stabilizing Griess reagent for explosives detection. United States Application 20070065944

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APPEARANCES AND EXPERT REPORTS

- Goldberg v. Goss-Jewett Company, Inc., et al., United States District Court, Central District of California. Case No. EDCV14-01872 DSF (AFMx). Deposition May 25, 2016; September 26, 2019. Expert Report. Rebuttal Report. Additional Rebuttal Report.
- David R. Hull, et al., v. JP Energy Marketing, LLC, et al. District Court of Love County, State of Oklahoma. Case No. CJ-2017-17. Expert Report
- City of West Sacramento, California, et al. v. R and L Business Management, et al., United States District Court, Eastern District of California. Case No. 2:18-CV-00900-WBS-EFB. Expert Declaration. Rebuttal Declaration.
- Von Duprin LLC v. Moran Electric Service, Inc. Major Holdings, LLC, Major Tool and Machine, Inc., and Zimmer Paper Products Incorporated. United States District Court Southern District of Indiana, Indianapolis Division. Case No. 1:16-CV-01942-TWP-DML. Trial July 31, 2019. Deposition June 7, 2018. Expert Report. Expert Declaration.
- King County, Washington v. Traveler's Indemnity Co., et al. United States District Court. Western District of Washington. Case No. 14-cv-1957. Deposition April 9, 2019. Rebuttal Report.
- Chemtronics Inc. v. Northrop Grumman Systems Corp. American Arbitration Association Arbitration. Case No. 01-17-0007-1884. Binding Arbitration November 12-13, 2018. Expert Report. Rebuttal Report. Supplemental Report.
- California River Watch v. City of Vacaville. United States District Court, Eastern District of California. Case No. 2:17-cv-00524-KJM-KJN. Expert Report. Expert Declaration.
- 220 W. Gutierrez, LLC v. Goss-Jewett & Co. Inc. et al. Santa Barbara County Superior Court. Case No. 17-CV-05689. Expert Declaration.
- Estate of Robert Renzel, Deceased et al. v. estate of Lupe Ventura, Deceased, et al. United States District Court, Northern District of California. Case No. 4:15-cv-1648-HSG. Deposition August 27, 2018. Expert Declaration. Expert Report. Rebuttal Report.
- Siltronic Corporation v. Employers Insurance Company of Wausau et al. United States District Court, Central District of Oregon. Case No. 3:11-cv-01493-BR. Deposition May 24, 2018. Expert Report.
- Arrow Electronics, Inc. v. Aetna Casualty & Surety Co., et al. United States District Court, Central District of California. Case No. 2:17-cv-05247-JFW-JEM. Expert Report. Rebuttal Report.
- Power Authority of the State of New York v. The tug M/V Ellen S. Bouchard, et al. United States District Court, Southern District of New York. Case No. 14-cv-4462 (PAC). Deposition May 30, 2018. Expert Report.
- Crown Central, LLC v. Petroleum Marketing Investment Group, LLC, et al. Circuit Court for Baltimore County, Maryland. Case No. 03-C-16-010774 CN. Deposition December 19, 2017. Expert Declaration. Rebuttal Declaration.
- Sunflower Redevelopment, LLC v. Illinois Union Insurance Company. United States District Court, Western District of Missouri, Western Division. Case No. 4:15-cv-00577-DGK. Deposition November 10, 2017. Rebuttal Report. Supplemental Report.
- Gary Puhr v. PQ Corporation. United States District Court, Northern District of Illinois, Eastern Division. Case No. 16-CV-00728. Expert Report.
- Insurance Company of the State of Pennsylvania v. County of San Bernardino. United States District Court, Central District of California. Case No. 5:16-cv-00128-PSG-SS. Deposition June 15, 2017. Expert Report. Rebuttal Report.
- Lennar Mare Island, LLC v. Steadfast Insurance Company. United States District Court, Eastern District of California, Sacramento Division. Case No. 2:12-cv-02182-KJM-KJN. Case No. 2:16-cv-00291-KJM-CKD860. Deposition May 26, 2017. Expert Report. Supplemental Report.
- Hanford Challenge, et al., v. Ernest Moniz, et al. United States District Court, Eastern District of Washington. Case No. 4:15-CV-05086-TOR. Expert Declaration. Supplemental Expert Declaration.
- K.C. Jones Plating Company, et al., v. Admiral Insurance Company. United States District Court, Eastern District of Michigan, Southern Division. Case No. 2:16-cv-10790-DML-MKM. Expert Report.
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- Searles Valley Minerals Operations Inc. v. Advanced Steel Recovery Inc., et al., California Ninth District. Central



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District Court. 5:2010cv01403. Deposition January 25,
2012. Expert Report. Rebuttal Report.

PROOF OF SERVICE

STATE OF CALIFORNIA, COUNTY OF ALAMEDA

At the time of service, I was over 18 years of age and **not a party to this action**. I am employed in the County of Alameda, State of California. My business address is 2120 University Avenue, Berkeley, CA 94704.

On December 9, 2019, I served true copies of the following document(s) described as **EXPERT REPORT OF ADAM H. LOVE** on the interested parties in this action as follows:

SEE ATTACHED SERVICE LIST

X BY MAIL: I enclosed the document(s) in a sealed envelope or package addressed to the persons at the addresses listed in the Service List and placed the envelope for collection and mailing, following our ordinary business practices. I am readily familiar with Environmental General Counsel LLP's practice for collecting and processing correspondence for mailing. On the same day that the correspondence is placed for collection and mailing, it is deposited in the ordinary course of business with the United States Postal Service, in a sealed envelope with postage fully prepaid.

X BY E-MAIL OR ELECTRONIC TRANSMISSION: I caused a copy of the document(s) to be sent from e-mail address bkoh@egcounsel.com to the persons at the e-mail addresses listed in the Service List. I did not receive, within a reasonable time after the transmission, any electronic message or other indication that the transmission was unsuccessful.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on December 9, 2019, at Berkeley, California.


BETH B. KOH

SERVICE LIST

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3:18-cv-01199***

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